The WELDING ENGINEER

May
1934
Vol. XIX No. 5

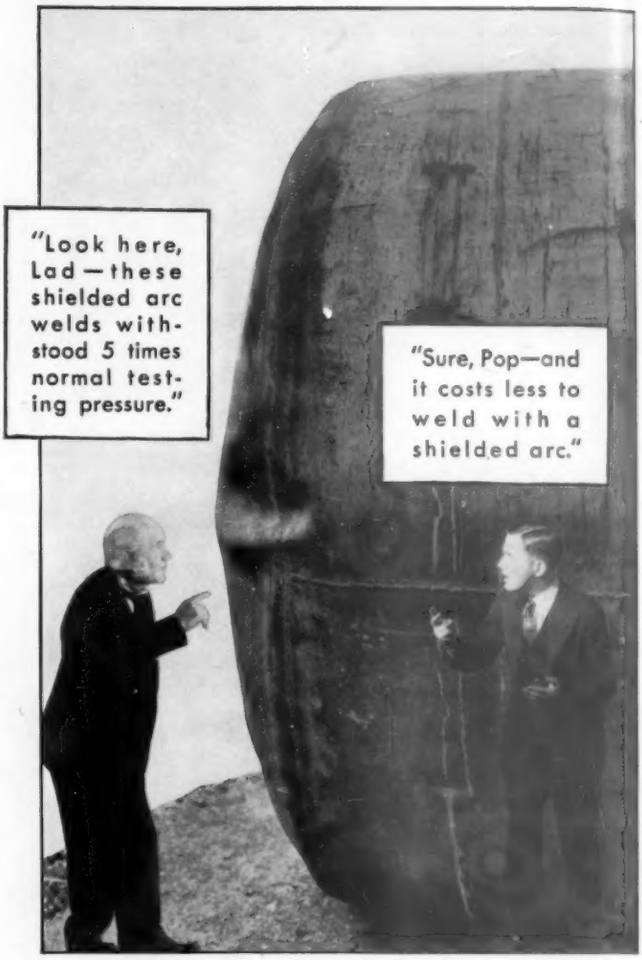
...ss offered no ob-
...s to the welding
...ner and fabri-
...r of the world's
...est waterwheel
...tor.

(See Page 27)

...neer Business and Technical Journal of the Welding Industry

MISTAKE

IN TESTING PROVES HIGH QUALITY OF SHIELDED ARC WELDING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ABP

THE WELDING ENGINEER

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MAY 1934

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RED STAR

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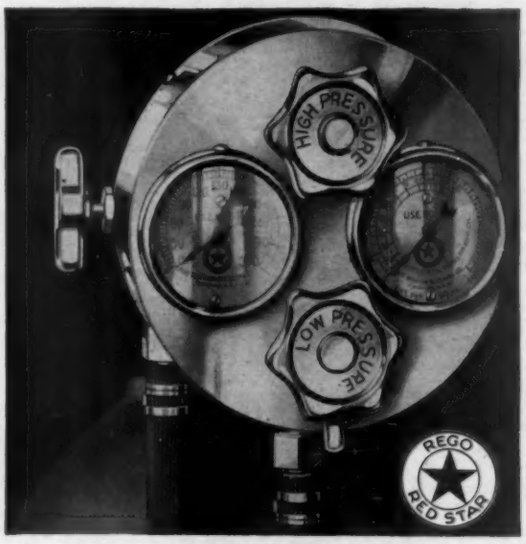

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· E D I T O R I A L ·

The Status of Qualification Tests for Welding Operators

● Much as it is to be regretted, classification societies in this country have never issued any approved tests for qualifying welding operators on structural steel work. The Code for Fusion Welding and Gas Cutting in Building Construction, Part A, of the American Welding Society, does not even make mention of qualification tests, though, odd as it may seem to the structural fabricator who is looking for enlightenment on this subject, Section B in the appendix to this Code is being used by various organizations, including the Federal Government, as a qualifying test, as explained in the March issue of *The Welding Engineer*. Yet this Section B is intended, in the code referred to, only to qualify the welding materials used, and not the operators, and even then its use is discretionary with the Superintendent of Buildings, as stated in Section 3, paragraph 2, of that code. Moreover, this test requires only butt-welded specimens, whereas structural steel welds are generally of the fillet type. In the report of the Structural Steel Committee of the American Bureau of Welding, dated September, 1931, these self-same tests were used to qualify welders for making the specimens on which the Committee based its report. The Committee, however, evidently recognizing a need for employing fillet-weld specimens in qualification tests, incorporated fillet specimens in its recommendations in the same report. In the qualifying of welders for structural-steel work, F. P. McKibben, in a paper presented a year ago before the American Welding Society annual meeting, suggested the use of the fillet-weld specimens recommended by the Structural Steel Committee. ¶ As matters stand, the buyer and the fabricator of steel structures have no recommended procedures to go by in setting up qualification tests for welding operators, save the tests as recommended by the Structural Steel Committee. The lack of recognition in the way of approval of qualifying tests for structural welding on the part of the American Welding Society or other classification societies has resulted in a state of confusion in the minds of those engaged in the erection of steel structures, and perhaps in large measure accounts for the hodge-podge presented by the varied qualification tests approved or proposed by State Highway Commissions. While the tests worked out by some Commissions show a knowledge of the work that has already been done along this line by capable investigators, several State Highway Commissions, on the other hand, have devised tests that are ambiguous in certain details and in some cases are ridiculous in their requirements. An excellent example of the former, however, is the test adopted by the Minnesota State Highway Commission and reported in this issue of *The Welding Engineer*. This test requires both butt- and fillet-weld specimens, the former being based on the tests in the A. S. M. E. Code for Unfired Pressure Vessels, Class II, and the latter being the fillet-weld test recommended in the report of the Structural Steel Committee, already referred to. These tests have been changed but slightly and then only with a view to making their application easier, without letting down the bars to high standards of welding. Of these changes, the greatest was the increasing of the ratio of width-to-depth of the free bend test specimen. ¶ The qualifying of welders is no small expense to fabricators, and in some cases shops who could readily have qualified their men under reasonable tests have foregone bidding on welded structures because the requirements regarding qualifications either were not clear or were so involved as to cause undue expense in making the specimens and having them tested, or they precluded any possibility of such tests being successfully passed. As an example of how one State Commission overdid this matter of qualification tests, they required a butt weld, with a heavy reinforcement retained, to withstand a free bend test, though the contractors attempting the test complained that the specimen always cracked, which was to be expected by anyone acquainted with tests of this nature. ¶ The tests outlined by the Minnesota Commission would indicate that enough information is available in the reports and codes of classification societies to evolve a good qualification test for structural welders. There is, however, an urgent need that the Structural Steel Code of the American Welding Society be brought up-to-date with recommended qualification tests that will serve as a model for Highway Commissions and other bodies.

Though the Sky-Ride Is Still There, It's a New Fair

● Those who come to the World's Fair (officially known as A Century of Progress) at Chicago this summer and expect to see nothing new since their visit of last summer, are due for a great surprise. Where roller coasters, human freaks, and 3x4 shops occupied the stage last year, there are now villages, complete in detail, transplanted from far-away Spain, Switzerland, Ireland, the Black Forest, and other places we know of only in books, with everything as perfectly proportioned as you would find in the Old World village. The Indian Village has given way to Henry Ford's huge exhibit and building. In a large auditorium built over the blue waters of the lagoon, weary travelers and music-lovers will listen to a large symphony orchestra on the stage giving the best in music. These comparisons are only a sample of what is in store for this summer's Fair visitor. And over it all will tower the Sky-Ride, with its welded columns—the supreme thrill of this year's Fair, as it was of last year's.

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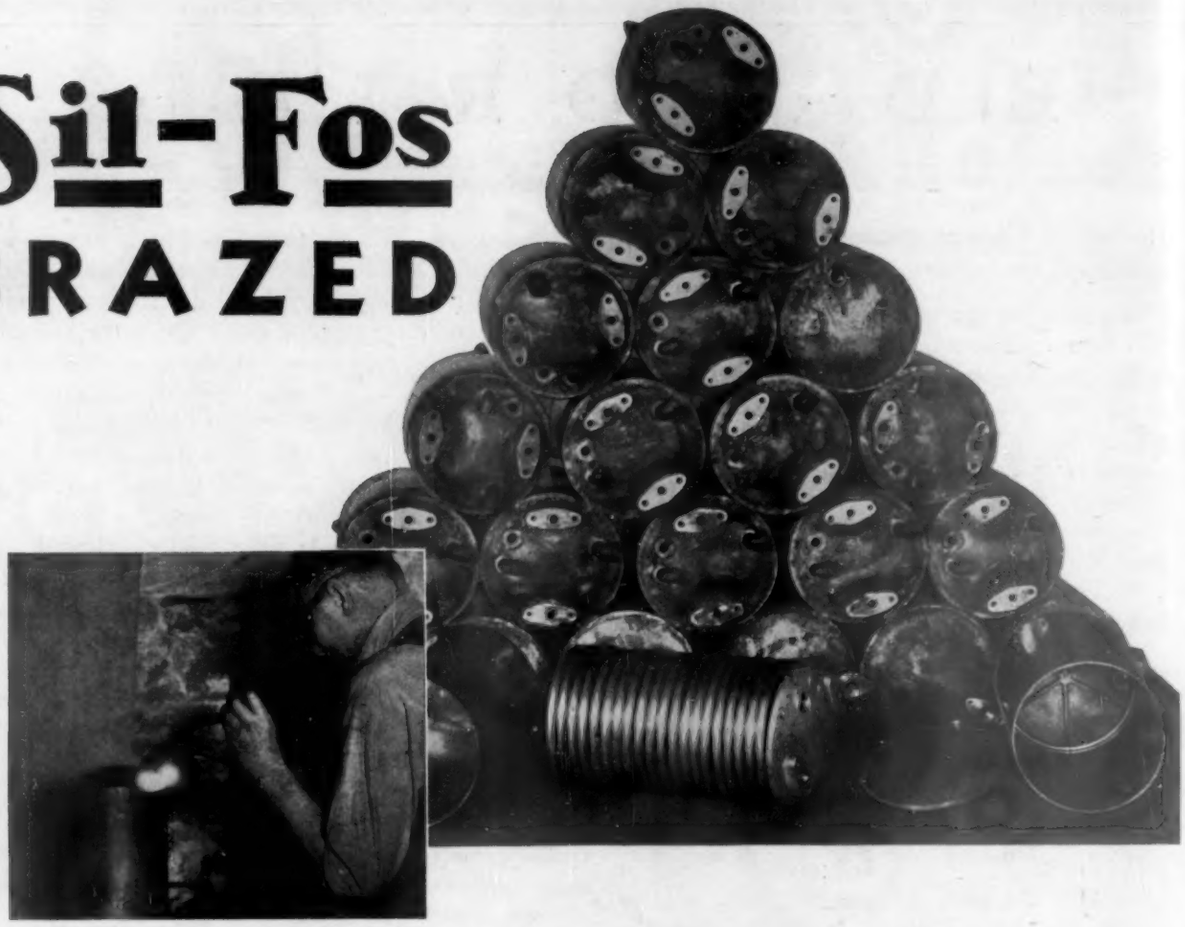

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● SIL-FOS can now be obtained from all distributing stations of the Air Reduction Sales Company in the United States, as well as from the many prominent supply houses who have carried it in the past.

HANDY AND HARMAN 82 Fulton St., New York

The Welding Engineer

VOLUME 19 MAY, 1934 NUMBER 5

Tests of Welds in Electrolytic Copper

Made With Standard Commercial Welding Rods

■ By W. J. CHAFFEE
The Hobart Brothers Co.

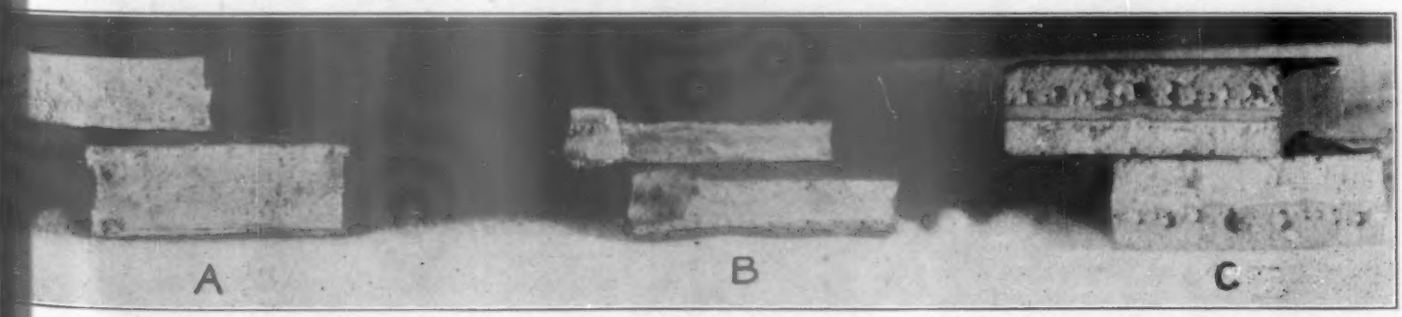
FOLLOWING the announcement by the writer in the Sept., 1933, issue of *The Welding Engineer*, of the first practical method of arc welding electrolytic copper with speed, economy, strength, ductility, tightness and freedom from warpage, so much interest has been shown in this new development that it seems in order at this time to make known the fact that the special rod for use with this welding procedure can now be purchased as Grade D Phosphor Bronze, making it possible for the copper fabricator to obtain his welding rod from the same company that supplies his copper sheets or plates. "Hobronz," mentioned in the previous article, is one of the trade names under which this rod is sold.

Meanwhile, several fabricators have asked if it would not be possible to use lower-priced bronze rods on special jobs where strength was not an essential requirement. In order to answer these questions, Robert Bercaw, who developed the "Long Arc" method of welding copper, has collaborated with the writer in making a series of tests to determine in a general way what might be expected in the way of strength, ductility, tightness, etc., when the lower-priced commercial rods were used.

PHOSPHOR bronze rod of "Grade D" makes welds having remarkably high strength and ductility, compared with other grades of rods containing less tin.

These tests were all made on electrolytic copper, because one of the advantages of the "Long Arc" method is that it does not require the use of the higher-priced deoxidized copper. Admitting that better results may be expected when welding deoxidized copper, the writer will confine himself to presenting the results of the tests made on the more economical electrolytic copper. The copper for the tests, as well as the five standard grades of welding rod used, was supplied by Revere Copper and Brass Incorporated, Rome, N. Y., and the welding was done by Mr. Bercaw in the Hobart Brothers factory at Troy, Ohio.

All test pieces were butt welded, two pieces of 4x12-in. copper being butted along the 12-in. dimension, forming a piece 8x12 in. after welding. Two test pieces were cut from the center of each plate (Fig. 1). The beads were not machined off, because in most practical applications of copper welding the bead is not removed. Hence, when testing to destruction, the tendency was to concentrate the stress at the edge of the bead, and all samples failed near that point. Tensile strengths were computed on the basis of the cross-section of the copper plate itself and not the cross-section of



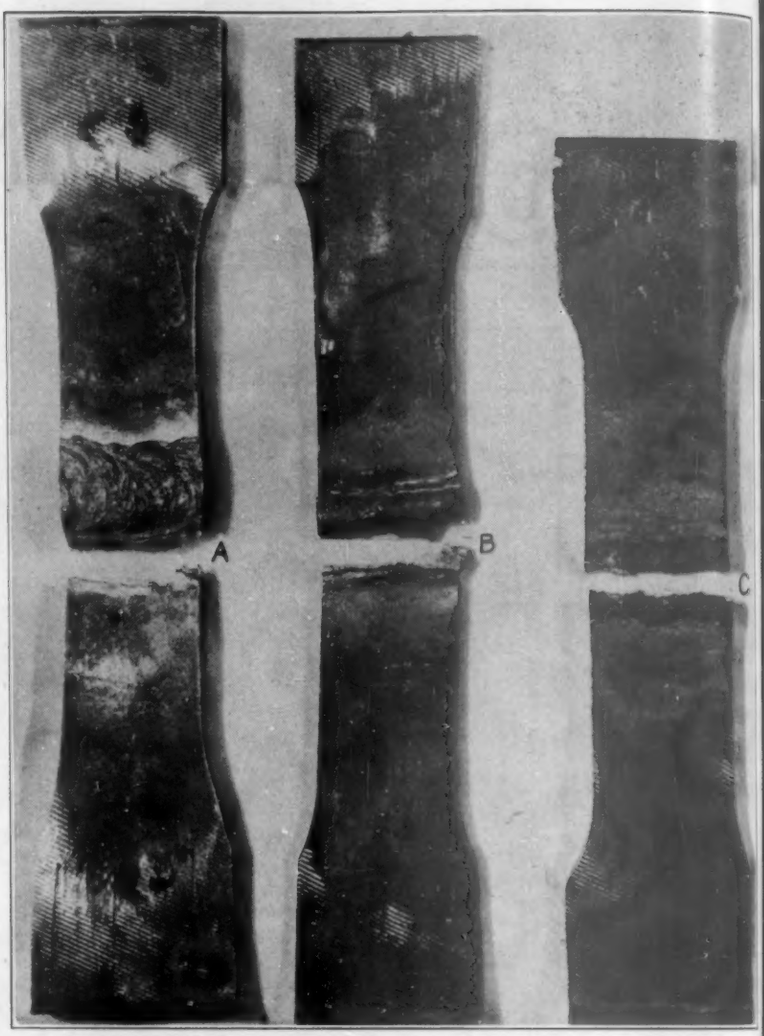
Fractures of Welds in Copper Specimens, Showing Welds Classified as "Go od" (A), "Fair" (B), and "Poor" (C). See Table II.

A shows a weld made on ½-in. copper plate with "Grade D" electrode, which showed approximately 97% tensile strength as compared with the original metal, with an elongation of 19.5%.

B shows a fracture in a weld on ¼-in. copper made with "Grade C" electrode, which showed approximately 96% tensile strength as compared with the original metal, with an elongation of 18.8%. It is classed as "Fair" because of the porous condition appearing at one end of the weld where a piece of the weld metal pulled away. The companion piece in this thickness and grade, cut from the same welded plate, also revealed slight porosity.

C is a weld on ⅜-in. copper made with deoxidized copper rod, which showed approximately 55% of the strength of the parent metal, with an elongation of 6.2%. The failure occurred directly through the center of the weld longitudinally, revealing an extremely porous condition of the weld metal. Note that neither of the two beads on this double-V weld penetrated even to the center of the joint. This is unquestionably a "Poor" weld for any purpose.

The Weld on ¼-in. Copper Made with Deoxidized Copper Rod Cracked Longitudinally While Cooling.



Another View of Fractured Welded Coupons, Same as Shown on Preceding Page.

the weld. All welds were made by the "Long Arc" method.

Plates of five thicknesses were prepared with each grade of welding rod, so that two pieces could be tested in each thickness or ten pieces for each grade of welding rod. The results listed in the accompanying tables are averages for the two pieces cut from each plate and also the average of all pieces in each grade of welding rod. Test pieces were also cut from the electrolytic copper itself, in the various thicknesses, to determine characteristics of the original metal for comparative purposes.

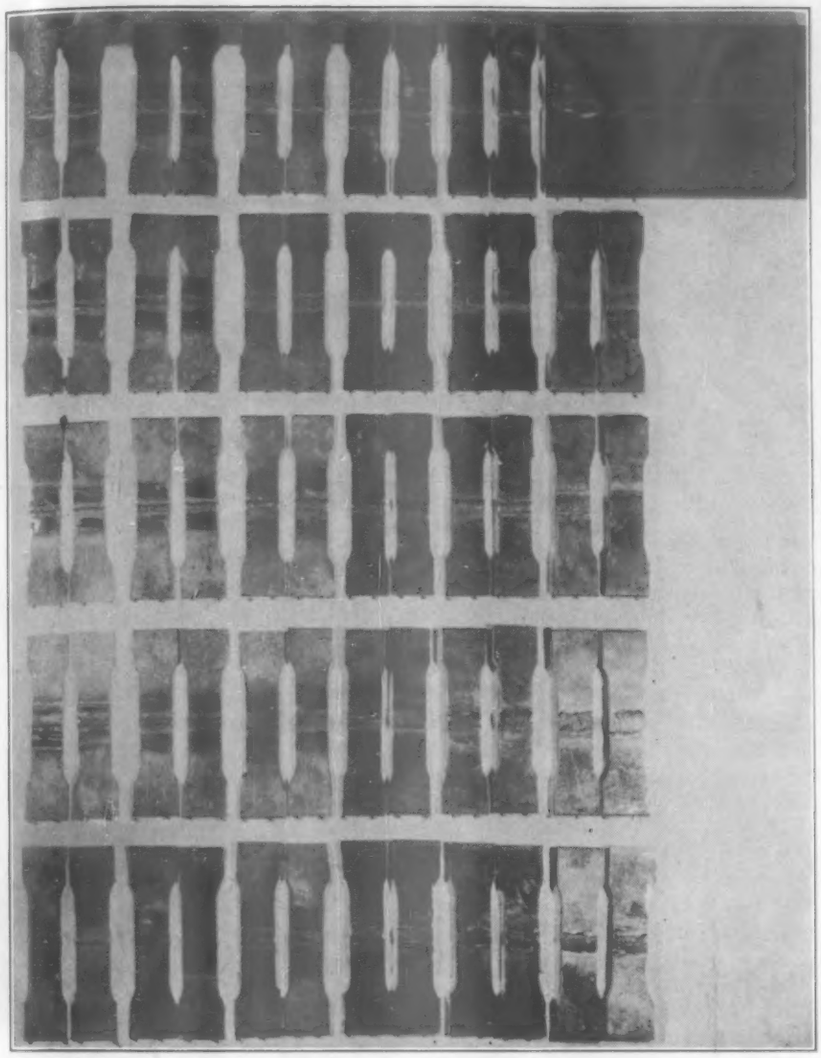
Space does not permit an exhaustive analysis of these tests. The tables and photographs, however, tend to confirm our previous belief that Grade D Phosphor Bronze ("Hobronz") is the proper rod to use for "Long Arc" welding of copper for all requirements. While the tests on 1/16-in. copper might indicate that lower-priced rods would give satisfactory results for some applications on copper of that thickness, it must be remembered that only two pieces were tested in each thickness, and attention should be directed more particularly to the average for all pieces in each grade (right hand column in each table).

It is not the intention of this article to recommend the use of different grades of welding rod for different thicknesses of metal, because in most cases such practice would be uneconomical. Mixing grades when purchasing forfeits quan-

Table I—Tensile Properties of Copper Welds Made by Various Commercial Rods.

Thickness of metal	1/16 in.	1/8 in.	1/4 in.	3/8 in.	1/2 in.	Average for all Pieces
Strength and Ductility of Electrolytic Copper						
Tensile strength, lb. per sq. in. .	33,600 lb.	33,973 lb.	32,533 lb.	31,111 lb.	32,000 lb.	32,643 lb.
Elongation in 2 in.	46.9%	46.9%	50%	62.5%	62.5%	53.76%
Welds Made With Deoxidized Copper Welding Rod						
Tensile strength, lb. per sq in. . .	30,375 lb.	24,400 lb.	21,600 lb.	17,244 lb.	(See	23,404 lb.
Compared with original metal. .	90.4%	70.1%	66.3%	55.4%	Foot-	71.6%
Elongation in 2 in.	14.05%	10.15%	9.4%	6.65%	note)	10.06%
Welds Made With Grade A Phosphor Bronze Welding Rod						
Tensile strength, lb. per sq. in. .	30,719 lb.	28,213 lb.	10,799 lb.	22,644 lb.	21,566 lb.	22,900 lb.
Compared with original metal. .	91.4%	83%	33.1%	72.7%	67.3%	70.1%
Elongation in 2 in.	15.2%	14%	3.1%	10.15%	10.95%	10.68%
Welds Made With Grade C Phosphor Bronze Welding Rod						
Tensile strength, lb. per sq. in. .	30,586 lb.	31,653 lb.	26,266 lb.	30,755 lb.	29,666 lb.	29,785 lb.
Compared with original metal.	91%	93.1%	80.7%	98.8%	92.7%	91.2%
Elongation in 2 in.	12.5%	17.2%	11.75%	17.6%	16%	15.01%
Welds Made With Grade D Phosphor Bronze Welding Rod						
Tensile strength, lb. per sq. in. .	33,039 lb.	33,519 lb.	29,866 lb.	27,911 lb.	30,233 lb.	30,914 lb.
Compared with original metal. .	98.3%	98.6%	91.8%	89.7%	94.4%	94.7%
Elongation in 2 in.	14.05%	23.8%	14.85%	13.7%	16%	16.48%
Welds Made With Grade E Phosphor Bronze Welding Rod						
Tensile strength, lb. per sq. in. .	32,733 lb.	21,548 lb.	27,773 lb.	19,644 lb.	17,333 lb.	23,806 lb.
Compared with original metal. .	97.5%	63.4%	85.2%	63.1%	54.1%	72.9%
Elongation in 2 in.	17.2%	9.75%	14.85%	7.85%	9%	11.73%

*Note:—The weld on ½ in. copper with deoxidized copper rod cracked longitudinally while cooling (see illustration at upper left of page). Hence, no pieces were tested.



All Tensile Specimens Were Cut From the Center of 8x12-in. Copper Plates, Butt Welded.

tity price concessions. Rods of lower tin content than "Grade D" slow up the operator's welding speed.

Furthermore, the only known successful applications of "Long Arc" welding on electrolytic copper to date have involved the use of only Grade D Phosphor Bronze ("Hobronz"). It is a matter of record that on one copper welding job, for example, about $100 worth of copper was wasted in attempts to do the work with other rods, special fluxes, and ordinary welding technique, before it was successfully completed by using the "Long Arc" method with "Grade D" ("Hobronz"). The loss of the copper, coupled with wasted time, demonstrated the false economy of using cheaper rods. This particular job involved about $900 worth of copper and about $40 worth of "Hobronz." The cheapest rod available (deoxidized copper) would have cost about $30, so it was a case of gambling $900 worth of copper against a possible saving of $10 on rod cost, to say nothing of increased labor cost due to slower welding speed, which would far more than offset the saving in material cost.

Table II—Internal Condition of Weld Metal as to Porosity.

Welds showing no evidence of porosity were classed as "Good," Welds with noticeable porosity as "Fair," and with excessive porosity "Poor".

Thickness of Metal	⅛ in.	⅙ in.	¼ in.	⅜ in.	½ in.	Summary for All Thicknesses
Deoxidized Copper.....	2 Good	2 Good	2 Poor	2 Poor		4 Good 4 Poor
Phosphor Bronze "A"...	2 Good	1 Good 1 Fair	2 Poor	2 Good	2 Poor	5 Good 1 Fair 4 Poor
Phosphor Bronze "C"...	2 Good	2 Good	2 Fair	2 Good	2 Good	8 Good 2 Fair
Phosphor Bronze "D"...	2 Good	2 Good	2 Good	2 Good	2 Good	10 Good
Phosphor Bronze "E"...	2 Good	1 Good 1 Fair	1 Good 1 Poor	2 Fair	2 Poor	4 Good 3 Fair 3 Poor

Taking everything into consideration, comparing the results shown in the tables herewith, and drawing upon his own experience, Mr. Bercaw, who developed the "Long Arc" method of arc welding copper, is unwilling to recommend any rod other than "Hobronz," which is now available as Grade D Phosphor Bronze. In the tests, this rod shows up as most consistently desirable from every viewpoint, which is undoubtedly due to its large tin content as compared with other commercial rods. Of all the commercial rods tested, this rod showed maximum speed, economy, tightness, strength, ductility, and freedom from warpage, and gave consistent results, compared with the other rods, in fabricating either electrolytic or deoxidized copper.

Gas Welding Approved for Water and Aircraft

The use of oxyacetylene welding in shipbuilding has now been sanctioned by the British Corporation Register of Shipping and Aircraft, as the result of tests of weld metal and welded specimens recently carried out by The Acetylene & Welding Consulting Bureau, Ltd., of London, whose Notice No. 39, recently issued, gives the specifications under which these tests were conducted, and a tabulation of the results.

Reservations Heavy for National Metal Show

In number of exhibits and size of space sold, the 1934 National Metal Exposition will set a new record for all years since 1929. On May 1st, space reservations exceeded the total of last year's exposition held in Detroit, according to W. H. Eisenman, director. This year's exposition and National Metal Congress will be held for the first time in New York City, and will be housed in the Port Authority Building at 111 Eighth Ave.

California Gets New All-Welded Pipeline

Sixteen miles of electrically welded pipeline for transporting crude oil is under construction at this time by Macco-Robertson, Ltd., pipeline contractors, of Clearwater, Calif. This line, which will be of 6-in. and 8-in. pipe, is being laid for the Union Oil Co. of California, and will extend from Weedpatch, in the Mountain View oil field, to the oil company's storage tanks at Oildale. Straight butt joints without back-up rings will be the method of welding employed. The line is scheduled for completion about June 1st.

Type of electrode, preparation of rail ends, technique of welding, and temperature of atmosphere are important factors in

Rail-End Welding

■ By W. M. B. BRADY
General Electric Co.

Paper presented at Iowa State College Welding Conference, January 26, 1934.

BORN of necessity during the World War, electric welding was adopted by one of the major industries of our country, the railroad, as an economic means of salvaging rolling stock. This was extended to other departments and, during the past few years of depression, the track and right-of-way departments have looked to electric welding to restore the like-new riding qualities to their rails, and at the same time to keep a balanced budget. The solution to the problem lies in the use of electric welding to build up rail ends that are battered by the impact of wheels.

On a certain railroad in the north central area of the United States, approximately 34 miles of continuous track recently was restored with eminent success, passing rigid tests and exacting inspection. The rails were 39 ft. long and weighed 100 lb. per yard. The track was originally laid in 1926 and 1927. As received from the steel mill, the rails had a Brinell hardness varying from 240 to 260; and at the time of welding, after years of traffic impact from service, this had increased to an average case hardness of 268 Brinell. The average hardness of the deposited metal immediately after welding was 305 Brinell. This deposit is also subject to further hardening due to the impact or cold-working by traffic.

The work was sublet by the railroad company to the International Rail Weld Corp., Chicago, Ill., and the contractor's work had to fulfill specifications in every detail before acceptance by the railroad. One of the requirements was that there could be no pit holes or any sign of undercutting at the end or sides of the batter.

Originally the equipment consisted of a Cletrack Model 25, mounting two General Electric type WD-22 generators, maximum rating 250 amperes, which completed over two-thirds of the distance. To expedite the work before the setting in of winter, additional equipment was employed on the last third of the distance. One Nordberg gas-engine-driven grinder followed each welding equipment. Each generator was provided with 100-ft. cables, thus spanning 200 ft. of track, or ten joints (both rails), requiring only ten to twelve moves of the tractor per day.

The crew on each welding outfit totaled five men, consisting of two welding operators (one for each rail), two grinding men (alternating at the grinding wheel), and one foreman, whose duties were to move and operate the tractor, mark up the joints and at the same time place sufficient electrodes at each joint for rebuilding, also to act as flagman in conjunction with the relief grinding man. It has been proved that the best way to expedite work is to clear the tracks of men, cables and grinding equipment at first sight or knowledge of an approaching train, rather than to wait to finish melting down an electrode or finish a cut with the grinder, for invariably this added time causes the engineer of the approaching train to slow down to half or less speed, requiring double or even triple time before the welding and grinding men can return to renew their tasks. Each crew worked two shifts of six hours each, equaling 24 welding hours and 24 grinding hours per day.

For rebuilding the battered rail ends of approximately 33 out of the 34 miles of track, practically all the electrodes used were the General Electric type W-90, ¼ in. in diameter, supplied through the Machinery & Welder Corp., Chicago, Ill. These electrodes were principally in 14-in. lengths, although near the completion of the work 18-in. lengths were adopted as more satisfactory. The power at the arc was 225 amperes at 45 volts. Approximately 9500 lb. of welding electrode was required on the 33 miles of track reclamation work.

Technique of Applying Rod to Rail

For such work, reverse polarity is recommended—that is, positive terminal to the electrode holder and negative terminal to the rail—although straight, or standard, polarity has been used with fair success. The technique of applying the electrode varies over a wide range, many details of which are good. However, I recommend that shown by the accompanying sketches as among the more

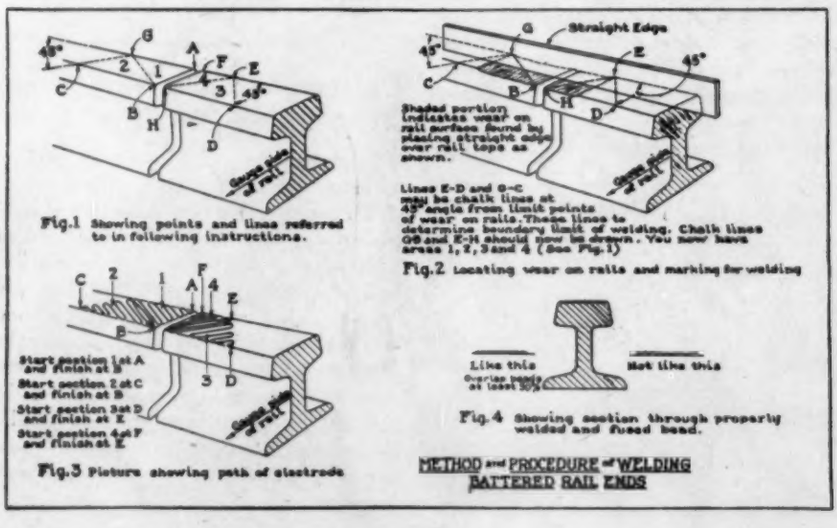


Fig.1 Showing points and lines referred to in following instructions.
Fig.2 Locating wear on rails and marking for welding
Fig.3 Picture showing path of electrode
Fig.4 Showing section through properly welded and fused bead.
Like this
Not like this
METHOD and PROCEDURE of WELDING BATTERED RAIL ENDS

practical. In following this procedure as well as the others indicated, the operator usually overlaps or bridges the electrode deposit from one rail to the other. This weld metal, when the rail ends are tight, should be cross-cut by a ⅛-in.-thick grinding wheel to a depth of 3/16 in. The electrode produces a very wide, flat and smooth bead requiring but a small amount of grinding. Only one layer of weld metal is sufficient to build up the average battered rail, which is usually worn down from 0.07 to 0.08 in.

As the length of batter along the rail will vary, it is most important to state this length in total inches measured along the rail, rather than in the number of joints welded per day. This was vividly illustrated in a recent check which indicated 108 joints, consisting of 1470 rail inches, making the average length of joint 13.6 in., which in this case equals 61 rail inches per hour per man. At another time, 728 rail inches were welded in 14 hours with one man, and at still another time, 626 rail inches were welded in 12 hours with one man; both of these instances correspond to 52 rail inches per man per hour.

Consideration of Stresses

In welding practice of any description, one is always confronted with the problem of resulting stresses to a greater or lesser degree, depending upon the job. These stresses cannot be disregarded if good results are to be obtained. Proper welding practice on battered rail ends necessitates a consideration of at least three phases of this problem, which may be listed as follows:

(1) Intensity of stresses.
(2) Location of stress or distribution of stress.
(3) Time at which stress occurs.

In the case of rail welding, there is another stress to be considered. This stress is actually a succession of impacts which is caused by a train passing over the deposit before the grinding operation has been performed. This being the case, some consideration of the changes in impact value with temperature change is again warranted.

The effect of the atmosphere cannot be disregarded, because this enters into the problem, as well as the temperature of the adjacent metal. It should be remembered that there is always a layer of comparatively cold air next to the deposit as the arc moves along; and since there is such a great change in temperature over the surface due to the arc, there is a considerable flow of air, which keeps this layer of air comparatively cold. Therefore, the temperature of the air must be considered, because it also will have a quenching action which, in turn, will have an effect on the resulting stress, causing a variation in impact value.

Influence of Temperature on Impact Resistance

This brings us to a consideration of the influence of temperature on the resistance to impact. Railroads have always been confronted with the problem of cracked rails in the winter time. Because of this, there has been considerable work done to determine the origin of the trouble.

In Mr. Cunningham's and Mr. Gilchrist's paper before the American Society for Steel Treating,* we find positive proof of a falling off in impact resistance of rails between 76° F. and 68° F. In one case the average impact value dropped from 78 ft.-lb. per sq. in. to 30 ft.-lb. per sq. in. at 27° F., and in another case from 30 ft.-lb. to 18 ft.-lb. over the same range.

The specific electrode referred to has a tensile strength of 105,000 lb. per sq. in. and an impact value of 20 ft.-lb. These properties, however, are not comparable to those of a weld deposit on a rail. It is to be expected that the impact value on a rail would be a little less, with a corresponding increase in tensile strength due to a probable increase in carbon content, the carbon having been drawn from the rail. The above has been pointed out to indicate the importance of carrying on a welding program under proper weather conditions. This electrode contains 0.25% carbon and 1.35% manganese. Tests made with ¼-in. diameter electrodes at 250 amperes, 45 volts, and 375 amperes, 43 volts, show melting rates of 6.75 and 10.20 lb. per hour, respectively, and deposition efficiencies of 44% and 45%.

The upper limits of carbon in the present American Railway Engineering Association specifications for 100 to 140 lb. rail were fixed on the basis of experience with lighter rails, and are given in Table I.

Records of the heavier rail in service have indicated that the specified carbon content may be too high, so consideration is now being given to lowering the upper limits of carbon and adjusting the manganese content. The proposed A. R. E. A. specifications are given in Table II.

The useful life of rail, after four to six years of service, depending on the amount of traffic and general right-of-way maintenance, will be more than doubled by having the battered ends built up by electric welding. In other words, rebuilt rail should give longer service than new rail, because of the durability of the deposited metal and the increased hardness of the weld deposit compared to the metal as delivered from the mill.

The able assistance of B. C. Tracey, Industrial Department, and J. H. Humberstone, Welding Engineering Department, General Electric Co., Schenectady, N. Y., in the preparation of data in this paper, is acknowledged.

*Transactions Am. Soc. for Steel Treating, Vol. 10, Nov., 1931 to June, 1932.

Table I. Present A. R. E. A. Chemical Requirements.

Constituents	Weight in lb. per yard			
	70-84	85-100	101-120	121-140
Carbon	0.53-0.70	0.62-0.77	0.67-0.83	0.72-0.89
Manganese	0.60-0.90	0.60-0.90	0.50-0.90	0.50-0.90
Phosphorus, not to exceed	0.04	0.04	0.04	0.04
Silicon, minimum	0.15	0.15	0.15	0.15

Table II. Proposed A. R. E. A. Chemical Requirements.

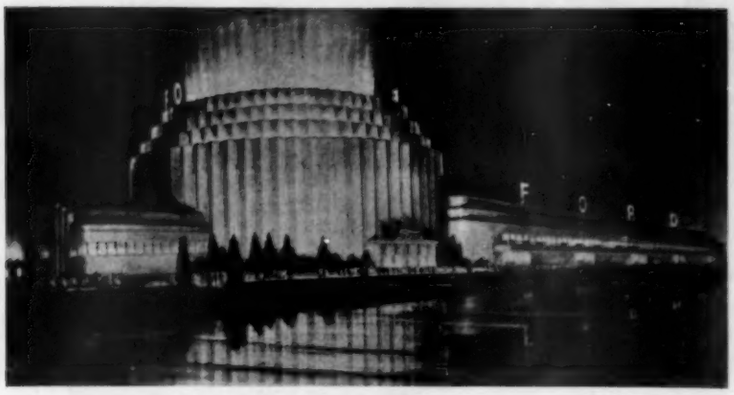
Constituents	Weight in lb. per yard			
	70-84	85-100	101-120	121-140
Carbon	0.53-0.70	0.64-0.77	0.67-0.80	0.69-0.82
Manganese	0.60-0.90	0.60-0.90	0.70-1.00	0.70-1.00
Phosphorus, not to exceed	0.04	0.04	0.04	0.04
Silicon	0.10-0.23	0.10-0.23	0.10-0.23	0.10-0.23

Large Sea-Going Dredger Repaired by Welding

Through welding, many hundreds of dollars were saved the War Department recently in an extremely heavy repair job on the large sea-going suction-type hopper dredger *A. Mackenzie,* of the U. S. Engineering Corps.

On a recent difficult dredging job, quantities of huge boulders weighing 40 to 50 lb. each were encountered. On being drawn through the suction hopper with terrific force, these boulders ruptured the casing of the huge pump, and wear and damage was done to the 26-in. piping leading to the pump. Repairs were made by welding a section of ¾-in. plate over the rupture and following this with heavy steel ribs welded over the entire repaired area. At the angles in the heavy piping, the wall of which is 1 in. thick, where the greatest wear occurs from the force of the dredged material, heavy reinforcing plates were welded. At some of these points, the force of the sand, gravel and rocks passing through the pipe had practically worn through the 1-in. pipe wall.

This heavy job of welding was handled by the Standard Iron Works, of San Diego, Calif., while the dredger was docked at the wharf in San Diego harbor.



This Structure, One of the Largest Ever Built for Exhibition Purposes, Will Use More Than One-Third as Much Current for Power and Light, as Was Used in the Entire World's Fair of Last Summer

Welded Steel Building at Century

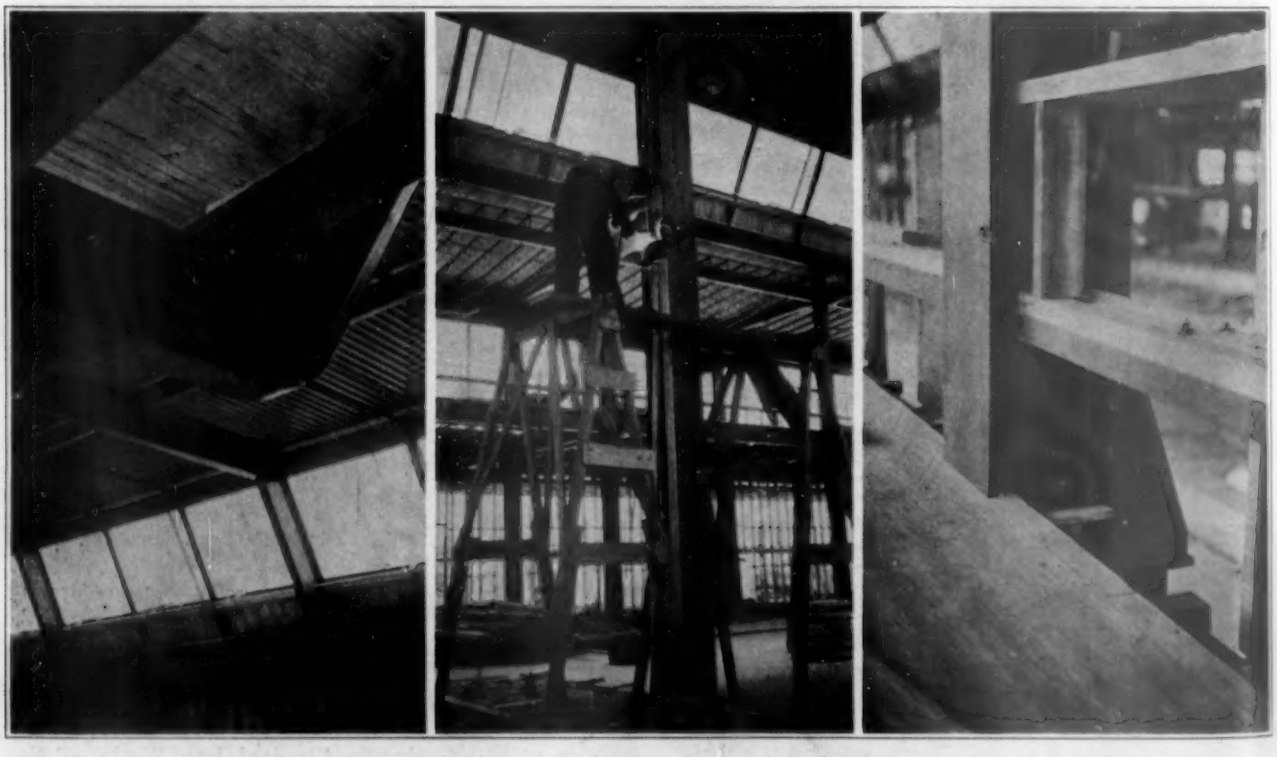
IN THE construction of the new Ford Building on the grounds of A Century of Progress in Chicago, the world's largest builder of automobiles places full confidence in good welding applied to ground structures the same as he does to the many welded joints in his cars.

If one walks through the Ford building, starting at its north end and continuing south through the north wing, which houses the Ford Industrial Exhibit, then through the central rotunda, which is the height of a 10-story building, and finally emerging at the south end of the south wing, one will see very little of the 1500 tons of steel which went into the framework of the building; but that which is most conspicuously exposed and which is likely to catch the visitor's eye are the welded frames for supporting the monitor-type roof of the north wing. Another interesting application of welding, though hidden from the eye of the visitor, pertains to the method used for supporting the ends of cantilever beams to the columns near the east wall of the north wing.

Welding was also used for fastening the steel floor joists and bridging, as well as for the butt joints and bearing plates on the tubular columns at the extreme north end of the building, and for fastening in place a number of small I-beams which had to be relocated because of changes in plans.

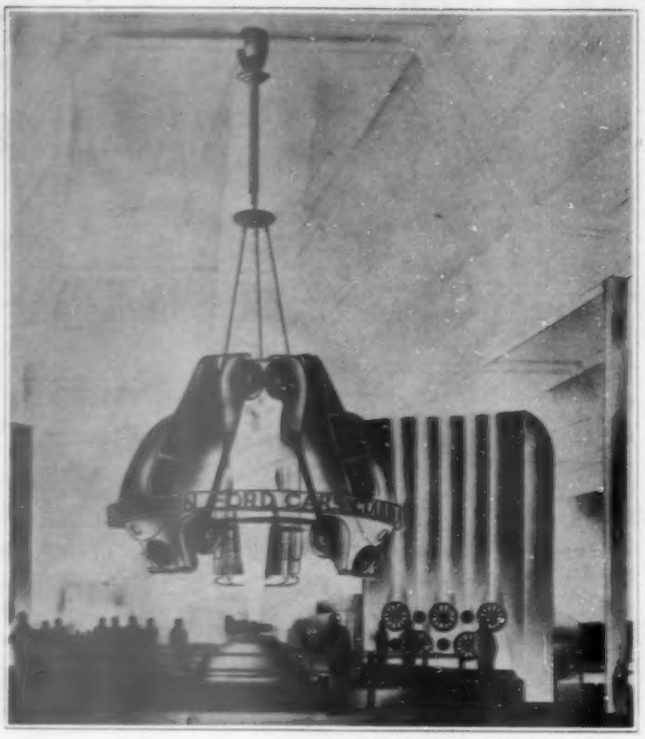
The 64 welded frames for supporting the monitor roof of the north wing were, in effect, single beams cut, bent and welded to make a rigid frame without the maze of steelwork presented by built-up monitor-roof trusses. Fifty-eight of these frames are 40 ft. long, built of 21-in., 73-lb. H-sections, and there are six smaller frames built of 12-in. sections constructed in a similar manner. These frames were built by the R. C. Mahon Co., Detroit, Mich., and shipped complete to the Ford Building site. The accompanying sketches show how the beams were cut with the torch and bent and welded at the two outer joints. At each joint, reinforcing struts were welded on each side of the web. The two center joints were made by cutting entirely through the beam at the required angle, and welding.

Three such trusses, joined end to end, are necessary to span the building from east to west. The ends of each truss are



Applications of Welding to Structural Steelwork.

Left—Close-up view of joint of monitor frame cut and welded as shown in diagram on opposite page. Center—Welding a bracket to one of the columns. Right—A welded connection between a cantilever beam and plate riveted to column face.



In the Industrial Exhibit in the North Wing of the Building, a Welded Roof Beam Supports Three Standard Ford Cars, Suspended from a Welded Spoke Wheel, Having a Capacity of Supporting 14 Cars

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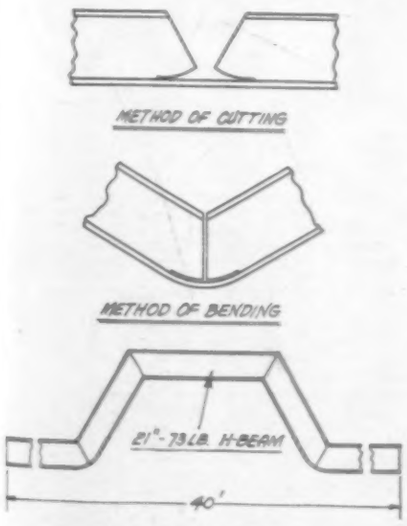
framed into columns by riveting, there being four rows of columns. Beyond the outer rows of columns, on each side of the building wing, as well as at the north and south ends, is a balcony entirely surrounding this wing of the building. The east wall of this wing, which is about 500 ft. long, contains no columns for support, so the balcony, which takes up the space between the outer row of columns and the east wall, must be supported entirely by these columns. This is accomplished by using a cantilever design for the beams supporting the balcony and the outer wall. Each column supports two such beams. A ½-in. plate is riveted to each of the column flanges and extends out beyond the edges of the flanges, so when the beam is in place it rests on the edge of the plate fastened to the outside face of the column, while the end of the beam bears upward against the edge of the plate riveted to the inner face of the column. The beam is welded to the edges of both plates by means of fillet welds on each side of each plate edge. Some of the columns are 16-in. H-sections, and some are 12-in. H-sections, while the beams are 21-in. H-sections.



Drawing by courtesy of The Lincoln Electric Co.

Method of Making Frame from H-Beam.

One hundred and forty tons of steel latticed floor and ceiling joists in the north wing are welded to the floor beams, and all bridging between joists is also welded. The ends of the joists rest on the beams and are held in place by short weld beads.

U-shaped brackets also are welded to a number of the columns, these being made up from ¼-in. steel plate, and the legs of the U are welded to the inside faces of the column flanges.

Eight small floor beams at the north end of the north wing were relocated because of change in plans, and were welded in their new positions, this being quicker and more economical than drilling new holes and riveting.

At the extreme north end of the building, the roof extends out over an outdoor balcony and is supported by four columns, each consisting of two sections of 6-in. pipe butt-welded together. Anchor or bearing plates are welded to top and bottom of these columns.

The L. J. Friestedt Co., Chicago, Ill., was in charge of the steel erection.

Interest in the Ford exhibit does not end with the design and erection of the structure housing it, but those connected with the welding industry will also be interested in the "chandelier," consisting of three standard Ford cars suspended from a standard welded steel spoke wheel, which in turn is suspended from one of the welded monitor frames; also, the flash welding demonstrations bid fair to attract large crowds. But that is a story to be told at another time.

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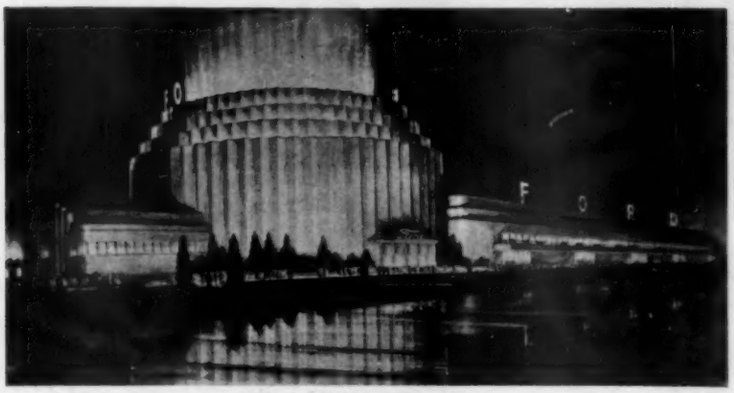

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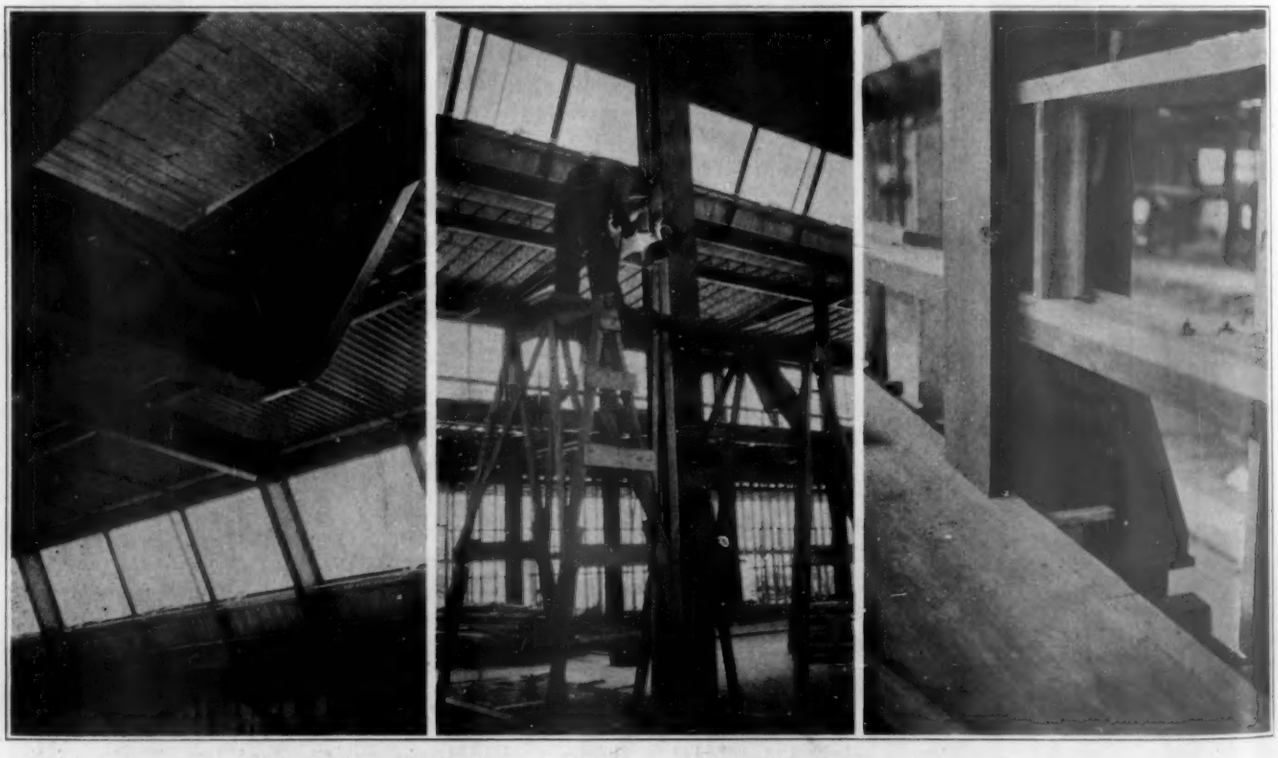

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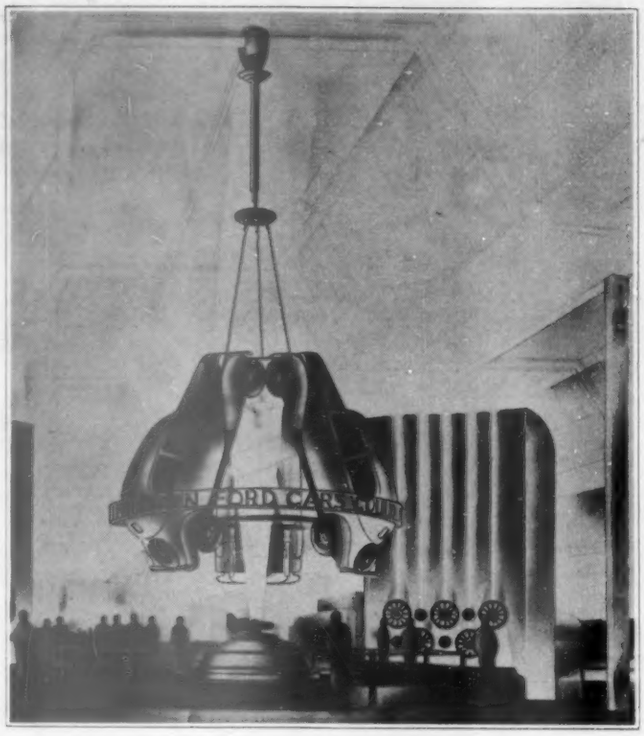

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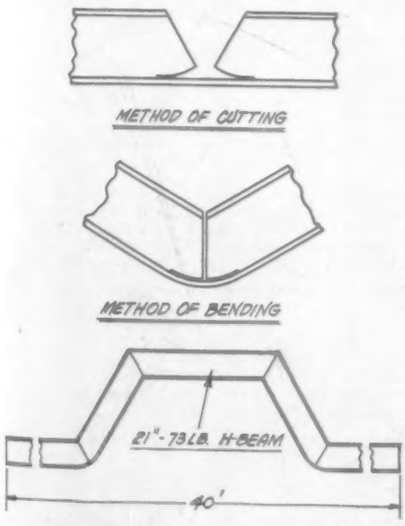

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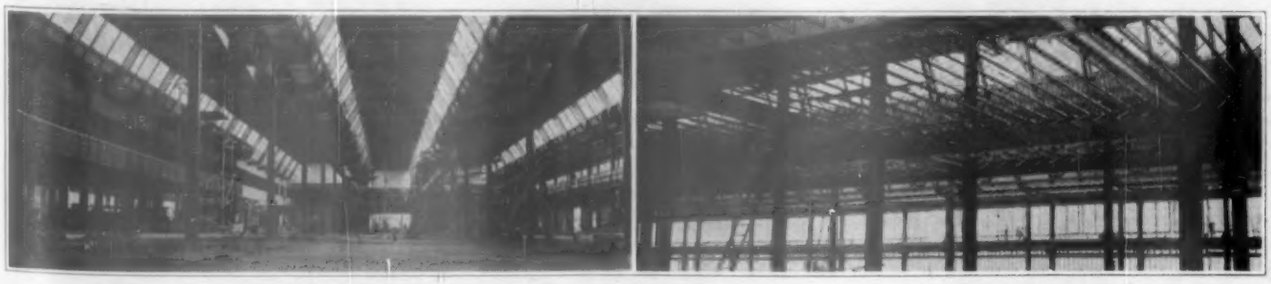

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Minnesota Qualifies Operators for Bridge Construction and Repair . . .

■ By L. C. MONROE

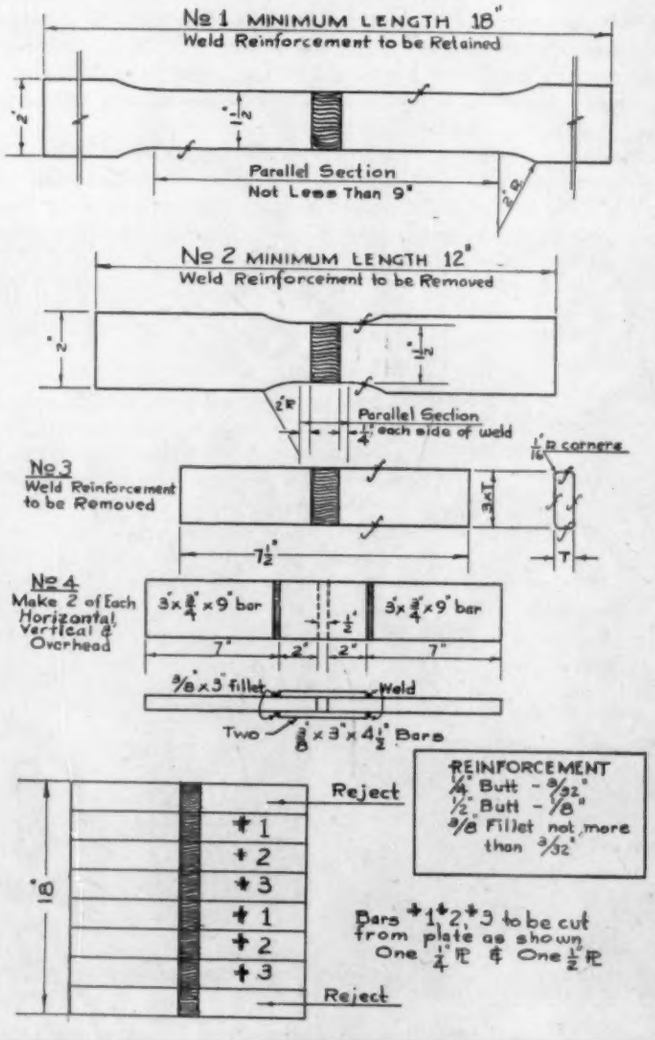
ANTICIPATING an increased adoption of welding in new construction as well as for alteration, maintenance and repair, the State of Minnesota Highway Commission recently set up a qualification test for all welders. Before being allowed to weld on any highway project or do any of the small repair work, the operator must pass this test, and the same applies to any employee of the highway department whose duties may be those of a welder. The details of this test are explained in the accompanying diagrams.

The sponsor of this test is Lyle A. Dills, chief inspector for the highway department, whose investigation of tests of various kinds resulted in the development and adoption of the test as given here. Mr. Dills anticipates that the requirements set forth will produce more consistent results in welding than if a qualification test were not required, since it will serve as a check on the ability of the individual welder. Moreover, Mr. Dills' experience confirms the fact that a man may be a good welder on tanks, but might burn his work when put on structural steel; or he might be efficient on down-hand work, but not be able to do good vertical or overhead welding.

When a contract is let for reinforcing a bridge, or making some alteration or repair, the welder is required to do position welding, and his ability on these points must be known. Inspectors can inspect, but cannot watch the applying of every ounce of metal, says Mr. Dills, and it is not practicable to cut out sections for tensile testing unless there is grave doubt as to the quality of the weld. It is easy enough to condemn a weld, but that makes for unpleasant relationship as well as an increased cost to the contractor. Like a problem in mathematics,

TESTS FOR QUALIFYING WELDING OPERATORS

Prepared by Minnesota State Highway Commission



All welding shall be prepared and done only by Qualified Welders. Such welders will be qualified for a period of one year by making and successfully passing the qualification tests required.

Weld specimens to be made shall include butt welds of ¼-inch and ½-inch plate and fillet welds of ⅜-inch bars as shown on details for Qualification Test Bars. Re-qualification of previously Qualified Welders may be made by successful preparation of required Operation Test Bars. Such Operation Tests may be made at the location of welding work to be done, and may be made as a check test from time to time to determine quality of work being done by various welders, and machines and rods being used.

Preparation of all weld test specimens shall be made in the presence of a qualified welding inspector who shall record all operations. Inspector's record shall include name and address of company, name and address of welder, experience of welder, type of welding unit, type of control, voltage and amperage during each run, number of runs, type of welding rod used, type of joint welded (sketch), time taken to complete run of weld, position of base metal during weld, and any other information on operation that may be of importance. This information along with laboratory results of tests shall be filed for future reference as to the welder's qualification. A report on test results will be furnished to the welder after completion of laboratory tests.

In the preparation of welding specimens all materials, equipment, power, labor and machining costs of specimens after welding shall be furnished by the welder or welding contractor without any monetary compensation for the same. All tests of specimens shall be made by the Minnesota Highway Dept. and rating of same shall be in accordance with the following specifications:

Test Bar No. 1—rated for efficiency, to show approximately 100% with the range strength of the plate (55,000 lb. to 65,000 lb. per sq. in.).

Test Bar No. 2—rated for weld strength to show a minimum ult. strength of 45,000 lb. per sq. in. and an average of 52,000 lb. per sq. in.

Test Bar No. 3—Free Bend Test to show elongation of weld fibers not less than 10%.

Test Bar No. 4—Fillet Weld Test to have a minimum ultimate tensile strength of 72,000 lb. for each specimen.

Test Bar No. 5—Wedge Test to show proper fusion of base metal with weld metal and proper root penetration. Any defects shall not be more than 1/16 in. in any dimension and shall not average more than 2 defects per linear inch of weld.

Each welder shall prepare and complete his test welds without assistance of inspector or foreman during operations. Butt welds are to be made from one side of plate only, in a horizontal position, the ends tacked before running weld and the welds to be reinforced 3/32 in. for ¼-in. plates and ⅛ in. for ½-in. plates. Fillet welds are to be made on clamped specimens and shall not be reinforced more than 3/32 in., through throat, for ⅜-in. fillets. Specimens shall not be annealed or altered after weld run is complete. Craters of fillet welds are to be filled.

Operation Tests shall be as shown on details for Operation Test Bars, fillet weld being similar to No. 4 of Qualification Test Bars. In addition, a Wedge Test Bar No. 5 shall be made and broken in presence of the welding operator for observation of the fracture.

Two specimens of weld rod or wire shall be furnished for laboratory test of each kind and size of rod used in making test welds. Only plain or coated rods shall be used in making these tests. Special asbestos or other covered rods, or special cored rods, shall not be used unless request for such test is made.

All specimens shall be carefully marked by the inspector to identify same with his report.

All machining of test specimens shall be carefully done so that any tool marks that remain shall be lengthwise of the bar.

if all the factors are known, the correct answer can be obtained. Hence, welders are made to pass a qualification test before going on highway jobs.

No attempt is made to qualify concerns who bid on highway jobs, but the test must be passed by each individual welder that the successful bidder puts on the job.

The instructions furnished to those taking the test are reproduced here, and they require that "each welder shall prepare and complete his test welds without assistance of inspector or foreman during operations." The reason for this requirement, as explained by Mr. Dills, is that the blueprints and instruction sheets are felt to be sufficiently clear—in fact, as understandable as any blueprint or instructions can be made — and if a welder cannot follow them to the letter after ample time is given for study, then how can he be expected to follow correctly instructions on jobs in the field, when the field instructions are submitted in the same form and with the same degree of clarity as the qualification-test instructions? Hence, the ability to read blueprints is a part of the qualification test, though not so stated. One welder submitted coupons having double-V butt welds; this, naturally, is a black mark against him.

All test welds are made in the presence of a highway department inspector and are welded with electrodes conforming to American Welding Society Specifications E-No. 1 B as to chemical composition, and of either the bare or coated type. Shielded-arc wire is not allowed in making this test, unless otherwise specified.

Upon completion of the coupons they are submitted to the State Highway Department Laboratory, in care of the Engineering Department, at the University of Minnesota, for testing.

Extensive Program of Bridge Repairing

One of the problems confronting the highway department is the inadequacy of highway bridges. All bridges have a 28-ft. roadway, which is ample width for present-day conditions; but when these bridges were built, it was little dreamed that they would be called upon to handle loads as carried by modern trucks and trailers. These bridges must be reinforced or be replaced altogether. Reinforcing by welding offers an economical method of increasing their capacity.

The highway department is confronted with the need for strengthening the bridge shoes, which carry the weight of the bridge and rest on the piers or abutments. The only solution to this problem is welding, since there is no room to add more rivets.

American Welding Society Elects New Officers

The newly elected president of the American Welding Society is David Schenck Jacobus, advisory engineer for The Babcock & Wilcox Co., New York City. Other officers elected for the ensuing year are: senior vice-president, J. J. Crowe (re-elected), engineer in charge of apparatus research and development, Air Reduction Sales Co., Jersey City, N. J.; treasurer, C. A. McCune (re-elected), consulting engineer, New York City; and secretary, Miss M. M. Kelly (re-elected).

Newly elected divisional vice-presidents are as follows: New York, New England Division—A. G. Leake, The Leake & Nelson Co., Bridgeport, Conn.; Middle Eastern Division—W. W. Reddie, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.; Middle Western Division—C. L. Eksergian (re-elected), Budd Wheel Co., Detroit, Mich.

The five elected directors are: A. M. Candy (re-elected), Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.; J. H. Deppeler (re-elected), Metal & Thermit Corp., New York City; A. E. Gaynor (re-elected), John A. Roebling's Sons Co., New York City; O. E. Hovey, American Bridge Co., New York City; and L. S. Moisseiff, consulting engineer, New York City.

All officers of the American Bureau of Welding were re-elected.

April and May Meetings of Los Angeles Section

The April 19th meeting of the Los Angeles Section of the American Welding Society was attended by a large number of members and visitors, including the evening welding class of the Frank Wiggins Trade School and its instructor, W. P. Fisher.

Frank Howard, chairman of the Committee on Welders' Qualifications, read a report from the San Francisco Section telling of the progress they have made along this line. The two sections are cooperating in the work of developing a general code for welders' qualification tests.

Another feature of the meeting was an interesting talk by Karl Strobel, president of the Karl Strobel Corp., of Puente, Calif. Mr. Strobel's talk was on the subject "The Future of Welding," and dealt with both the oxyacetylene and electric processes.

The May meeting of the Los Angeles Section of the American Welding Society is scheduled as a joint meeting with the Los Angeles Section of the American Society for Metals, formerly known as the American Society for Steel Treating, to be held on Tuesday evening, May 15th, at the Elks' Club at 6th St. and Park View, near Westlake Park, in Los Angeles.

The feature of the program is motion pictures and slides illustrating the great Boulder Canyon government project, showing the manner and procedures employed in fabricating the huge steel penstock being manufactured and installed at this time. The films and slides are to be shown through the courtesy of The Babcock & Wilcox Co., manufacturers of the large penstock, whose representative will make comments on the pictures.

Preceding the feature of the meeting, and immediately following the usual dinner at 6:30, Herman A. Nater, vice-president of the Bank of America, will talk on the subject, "Stabilization."

Summer Meeting of Gas Manufacturers

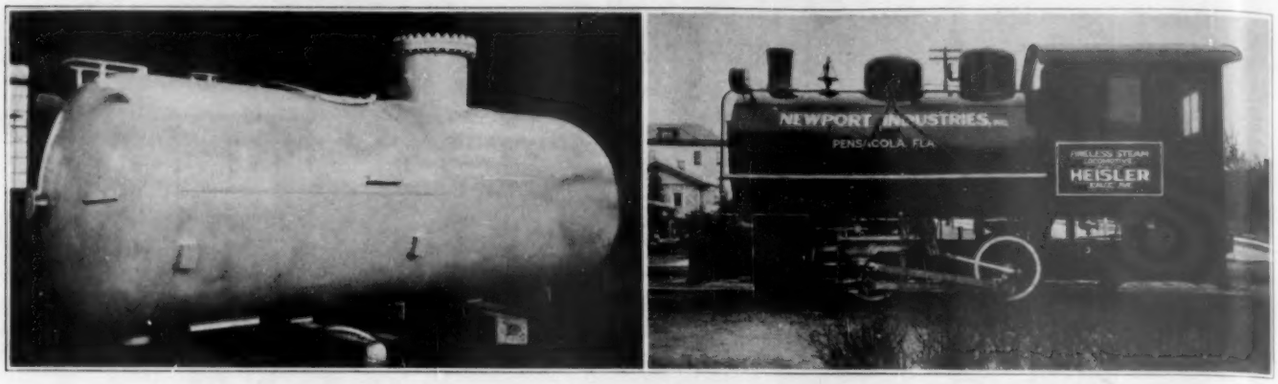
The Compressed Gas Manufacturers' Association, Inc., will hold their summer meeting on the evening of June 14th, at the Seaview Gold Club, Absecon, N. J. Proposed changes in the by-laws will be voted on. The following two days, the 15th and 16th, will be devoted to golf and other social activities being arranged by a committee headed by W. P. Uhler.

Chicago Group to See How Metallic Arc Looks

Motion pictures of the metallic arc will be shown by Robert W. Holt, of the Chicago Steel & Wire Co., at the meeting of the Chicago Section of the American Welding Society, to be held at the Bismarck Hotel, the evening of May 18th. These unusual pictures have only recently been completed by Mr. Holt, and will include black-and-white pictures and pictures in natural color, showing the welding arc and the weld puddle, using electrodes of low-carbon steel, heavy coated and bare, and rods of various alloys. The usual dinner and the annual business meeting will precede the showing of the films.

Detroit Contractors Elect Officers

New officers of the Detroit Section of The National Association of Welding Contractors, Inc., are: President, W. J. Thomas, of the W. J. Thomas Welding Laboratories; vice-president, R. K. Slaymaker, of the Slaymaker Welding Co.; and secretary and treasurer, G. A. Holtzhouse, of the Superior Welding Co. J. J. Hamburg, of the Smith, Hamburg, Scott Co., and F. R. Kilcoyne, of the United Welding Co., are directors.



Locomotive Equipped With Tank (Left) Welded Under Code Rules for Class I Pressure Vessels.

Steam Locomotive With Fusion-Welded Tank

The first known locomotive to use a fusion-welded tank is a new fireless steam locomotive built by the Heisler Locomotive Works, Erie, Pa.

Without boiler or firebox, this steam locomotive hauls a train of freight cars at rapid speed. The secret of the economy and unique advantages of this different type of motive power lies in the steam-charged arc-welded tank.

This tank is 69 in. in diameter and is built for a working pressure of 215 lb. It was built by the Struthers-Wells Co., Warren, Pa., using the shielded-arc process. Welding and testing were in conformance to Class I of the A.S.M.E. Code for Unfired Pressure Vessels. Welding was done with equipment manufactured by The Lincoln Electric Co., Cleveland, Ohio.

The tank, which is heavily lagged and jacketed to prevent loss of heat, is filled with water to about four-fifths of capacity. Then, by means of a steam pipe run from a stationary boiler to a point below the level of the water in the tank, the water is heated until the pressure and temperature in the locomotive tank are the same as in the stationary boiler from which the charge is being taken. It is from the heat thus stored in the water that the locomotive gets its power. For example, the tank on a 60-ton fireless locomotive, charged to 200-lb. pressure, stores sufficient energy to run the locomotive by itself over straight, level track a distance of about 95 miles, or to haul a train of three loaded freight cars weighing 210 tons a distance of 21 miles or more.

Riveted tanks used for fireless locomotives in the past have been a source of considerable trouble and expense, according to Heisler officials. "The rapid introduction into such tanks of high-pressure, highly superheated steam now found in many modern plants, causes such rapid expansion of the tank plates as to open up the rivet seams. This is a serious matter, as the tanks need to be heavily lagged and jacketed, making leaks difficult to locate and expensive to repair. Even with low-pressure steam, a riveted tank has to be very carefully fabricated, if laying up of the locomotive due to leaks is to be avoided."

Advantages claimed for the fireless locomotive are lower initial cost, reduced maintenance, one-man operation, longer useful life, and 60% to 90% greater hauling power. Since there is no smoke or fumes, the locomotive may be operated inside buildings.

Explosions with this type of locomotive are unknown, because there is no crown sheet to burn in the case of low water, and no staybolts to break or flues to fail and weaken the boiler. No excessive pressures are possible.

The simple tank construction enables every stress under all conditions to be calculated. This is not possible with a fired locomotive. Yet the factor of safety specified by the A.S.M.E. Code is used for fireless-tank design.

National Association Makes Further Gains

Since the emergency meeting of the National Association of Welding Contractors, Inc., held in Detroit, Mich., April 6th to 8th, which was reported in the April issue of *The Welding Engineer*, activities of the Association have gone ahead at a very satisfactory pace.

As reported by Dale George, president and managing director, the following local associations have joined the National Association since the Detroit meeting: Greater Philadelphia and Camden Association, Louisville (Ky.) Welding Association, Fairfield County (Danbury, Conn.) Welding Association, Ashland County (Ohio) Welding Association, and Grand Rapids (Mich.) Association of Welding Contractors. Other locals have signified their intention to join the national group.

Mr. George has been exceedingly busy since the Detroit meeting, bringing correspondence up to date and carrying on promotional activities. He has found time to meet with the Tri-State Master Welders Association, Wheeling, W. Va., which embraces the city of Wheeling and surrounding territory, including the towns of Steubenville, Bellaire, Bridgeport, Martins Cove, Burgettstown, Martins Ferry, Moundsville, and others. He has also met with the Ashland, Ohio, group and a group in Columbus, Ohio. He is planning a swing into Michigan soon, and local groups in that state desiring his presence should communicate with him, care of the George Welding Co., 79 W. Exchange St., Akron, Ohio. Mr. George will be glad to give anyone information or assistance in the formation of a local or regional association to affiliate with the National Association.

Certain local groups of welding contractors have misunderstood what is required of the NRA in the way of codes and have drawn up codes and submitted them to Washington for approval. Such codes cannot be considered until a national code has been approved for the industry, as is made clear in the following letter to one of these groups, written by Claude L'Engle, Aid to the National Recovery Administration, Division II, Washington, D. C.:

> It will be possible to have regional codes if there is a Master Welding Code.
>
> The main difficulty is to get a group or association nationally representative of the entire industry. To date we have received approximately nine local welding codes.
>
> The National Association of Welding Contractors, Akron, Ohio, with whom I am informed you have been corresponding, is, so far, the most nationally representative group.
>
> The Administration cannot write a code for this Industry. We can, however, advise you or anyone presenting a code regarding its formation.
>
> I realize that this industry needs a code and have been doing all within my power to be of assistance. I am trying to work with Mr. George on the many problems presented in the formation of a National Group. I believe that if you will keep working with and assisting Mr. George, we will eventually be able to get a Code for the Welding Industry.

It is evident that regional codes cannot be contrary to the letter or spirit of the Master Code, and hence the NRA takes the reasonable attitude that the consideration of local codes must await the acceptance and approval of a Master Welding Code for the nation.

Waterwheel Generators for Boulder Dam

When the waters impounded behind Boulder Dam are finally turned through the Boulder power station, the world's largest hydroelectric generators to date, born in the General Electric shops at Schenectady, will convert the mighty power of the Colorado River into electricity for transmission to Los Angeles, 265 miles away across desert and mountain.

The photograph on the front cover shows the arc-welded stator frame for the first of these huge machines, rated at 82,500 kva. The complete generator will be 40 ft. in diameter, 32 ft. high (above the floor), and will weigh over 2,000,000 lb. Disassembled into sections small enough to be shipped by rail, at least 40 freight cars will be necessary for the transportation of each generator to Boulder Dam.

Thermit Repair on Bucket

A fractured bail lug recently put the bucket of the dredge "Crest," belonging to the Great Lakes Dredge & Dock Co., out of service. This huge bucket, with a capacity of 14 cu. yd., would have been costly to replace, and the making of a new bucket would have meant weeks of delay. At the same time, repair by most methods presented many difficulties. With thermit welding, however, the job was a

Forged Bail Lug Welded to Shovel.

comparatively simple one and involved merely the making of a new forging to take the place of the part which had carried away and the welding of this forging to the frame of the bucket.

The repair was made by an operator of the Metal & Thermit Corp., with the help of a small crew recruited from the yard forces of the Great Lakes company. The new forging was first placed in position and carefully aligned, then a wax pattern was applied. The next steps were the building of a sheet-iron mold box, the ramming of the mold, and the usual preheating, in this case requiring six hours. The thermit was then reacted and poured and, after the weld had cooled thoroughly, the mold was removed and the job completed by cutting away the gates and risers. Twenty-one pounds of wax, 500 lb. of forging thermit, and five barrels of molding material were used.

Replaces Worn Rivets With Welding

With the rivets in the base badly worn, through many years of service, thereby necessitating repair, a crawler-type "Northwest" crane used at the Milwaukee briquette plant of The United Coal & Dock Co. was quickly put back into service by welding, whereas if repairs had been made by replacing the rivets, as was originally intended, the crane would have had to go into the shop and been laid up for many days, and still the problem of riveting in cramped quarters would have existed.

There were a total of 56 $\frac{7}{8}$-in. rivets that held the cast steel base to two H-beams. The base was $1\frac{1}{4}$ in. thick where it rested on the beams; and the beams, which were 9 in. wide, extended for about an inch beyond the edges of the base, making a shelf or shoulder all around the casting. It was decided to weld along this shoulder, but a heavy weld was needed to compensate for the 56 rivets.

At first, a fillet bead was laid, joining the base and H-beams together. Then a bead was laid parallel to the first pass and on the beam only. Successive beads were laid over these, and in this manner the weld was built up on a taper to the top of the base section. There was, all told, 16 lineal feet of welding, but many passes were required to build up the weld to its full height.

The job had to be done on top of a pile of run-of-mine coal, and inspection showed that there was insufficient clearance to drive rivets. Welding was suggested by Chas. N. Stevens, manager of the Milwaukee Boiler Manufacturing Co., which firm was awarded the contract for the work.

Draws Lessons From Aircraft Welding

"Welding in the Aviation Industry Which Directly Affects Structures," was the title of a talk given by J. N. Foster before the St. Louis (Mo.) Welding Society on April 27th. Mr. Foster, who is superintendent of the Curtiss-Wright Airplane Co., discussed many of the problems entering into the various parts of heavier-than-air craft, and showed how the information thus gained can be applied to the welding of other types of structures made of special alloys.

Death of Reg. K. Randall, Noted Instructor

News of the death on April 17th of Reg. K. Randall, president and founder of the Cleveland School of Welding, Inc., Cleveland, Ohio, came as a shock to his many friends in the welding field. Born in Quincy, Mass., in 1889, he entered the field of welding while it was still young and undeveloped. But it was as an instructor in welding that he was best known, being rated as one of the foremost authorities on welding and cutting instruction in the country. Prior to founding the Cleveland School of Welding in 1926, he was in charge of welding

R. K. RANDALL

instruction at the Cleveland Y.M.C.A., later being put in charge of the entire trade school.

Next to the devoted interest he took in his family, Mr. Randall's greatest hobby was his work in connection with the State of Ohio Rehabilitation Department, the Association for the Crippled and Disabled, and other like organizations. He trained more than a hundred seriously handicapped individuals to earn their living by welding. In this group were men having a leg, arm, hands, or fingers gone or crippled, and many were deaf mutes. In addition to teaching these men the welding trade, he built up their spirits and made life mean something to them, so they could go out and earn their way and take their place in society. Many of these men are now foremen welders.

As an example of Mr. Randall's interest in the physically handicapped, there is the case of the man who was crippled permanently by a fall from the top of a building. Through patience, Mr. Randall taught this man to weld and he operated a successful welding shop for several years.

His unselfish devotion to ideals, and his helpfulness to his fellowmen made his life an inspiration to many who knew him. Among the honors which had been conferred upon him in the past was the chairmanship of the Cleveland Section of the American Welding Society.

Fig. 1. These Welded Covers Replaced a Heavy Cast Cover.

Fig. 2. Design for Use With Electric Furnaces.

Stainless-Steel Covers for Furnace Annealing

Air-tight sheet-steel covers for the annealing and heat-treating of strip steel represent, as one steel man put it, "the first real idea the iron and steel industry has seen for some years in the matter of heat treatment." Naturally, the problem of excluding air is solved by welding all seams.

These covers, shown in the illustrations, are being manufactured and sold by the Walter J. Thomas & Co. Welding Laboratories, of Detroit, Mich. They are made of stainless steel and are guaranteed for 300 heats without re-welding.

Mr. Thomas obtained the idea for these covers while calling on one of his customers, when he saw an old heavy cast-steel cover about to be discarded. Though the mills have used the cast-steel cover for many years, Mr. Thomas has now converted some of them to the use of the lighter-weight, welded stainless-steel cover, because it is more economical and much more trouble-proof.

In Fig. 1, the three "Thomas" covers shown have a capacity equal to that of the cast-steel cover shown in the right background. These are designed for gas-fired furnaces, while the larger covers shown in Fig. 2 are intended for use with electric furnaces.

For the base metal, stainless steel was chosen, as it comes within the price range and will stand up under the severe conditions of service. It shows no atmospheric oxidation when withdrawn from the high temperature of the heating furnace and brought into immediate contact with the chilling outside atmosphere.

The cast-steel cover shown in Fig. 1 weighs about 15,000 lb., compared with 1685 lb. for a set of "Thomas" covers, and it is good for only approximately 150 heats, or about half the number for which the stainless-steel covers are guaranteed. Moreover, during its service life it will "camel back" or draw up in the middle, which necessitates cutting off the ends to effect a tight fit at the base, and this materially lessens its capacity. Also, the heats cause it to check, allowing air to infiltrate and reach the strip steel. For repair, welding has been tried, but no repair is considered permanent because of the "lifeless" condition of the casting brought about by alternate heating and cooling.

The use of the "Thomas" covers was found to increase the average charge of the furnace from 15 tons to 16½ tons, and the furnace time required to secure the desired Rockwell hardness test was reduced by approximately 7 hours, or almost 30%, resulting in great savings in labor and fuel, and an increased production.

The "Thomas" covers shown in Fig. 1 have an outside diameter of 33 in. and an overall height of 53 in., and are suitable for a charge height of 49 in. and a coil size of 32 in. Hence, there is very little loss of space. They are made of 3/16-in. steel for the gas-fired furnace and 12-gage for the electric furnace. The heads are pressed and flanged, and the sides are in one piece, rolled and welded.

Tire Molds Modernized at Big Savings

The entire inventory of tire molds of the Mansfield Tire & Rubber Co., Mansfield, Ohio, is being brought up to date by arc welding—resulting in an estimated saving of between $15,000 and $18,000 because an expensive "bullringing" operation is eliminated and the work speeded up.

The changeover work involves the annular grooves or rabbets which register the halves of the molds, these rabbets originally having a right-angled profile. To make the molds close properly without undue wear under constant use, the rabbets are being given a beveled instead of a right-angled form. This requires cutting away the female half of the mold to the desired angle and the building up and machining of the male half to the same angle. A 200-ampere General Electric arc welder and G-E Type M welding electrodes are used to deposit the additional metal required on the male half of the mold.

The welding, in charge of J. N. Williard, contractor to the rubber company,

Building-Up Tire Mold With the Arc.

goes on nearly 24 hours a day, and it is estimated that between five and six months will be required to complete the job.

It's No. 24 Rod Not No. 25

The rod used by the General Welding Products Co., of Indianapolis, Ind., in the manufacture of small all-welded, aluminum-coated, steel boilers, is not the Oxweld No. 25 rod, as stated in the article entitled "Aluminum Coating Cuts Down Heat Radiation," in the April issue of *The Welding Engineer*, but is the No. 24 rod, which is the rod recommended for use with the "Lindeweld" process. The No. 25 rod is a bronze rod, and obviously it would not be used for the purpose described.

Charred Remains of Welding Shop After Fire Which Followed the Explosion of a Crude-Oil Truck Tank That a Welder Was Repairing.

Hurry-Up Repair on Tank Causes Tragedy

By W. E. ARCHER

Ignorance and haste in the welding of crude-oil tanks and other inflammable liquid and gas containers have been the cause of much needless loss of life and damage to property.

The accompanying photos are forceful reminders of this fact. An inexperienced welder was recently left in charge of a shop in southern California when a "rush" job came in. A crude-oil truck tank and trailer, having been in a slight wreck, causing a break in one of the seams of the trailer unit, were brought in for welding. The owners of the truck were in the usual "big hurry" for the tank, and not realizing the importance of having the tank properly cleaned, induced the welder, who was inexperienced in this line of work, to proceed with the repairs without first ascertaining if the tank was safe for welding.

A Weld That Was Never Finished.
In repairing the crack, the welder completed several inches of the weld before the gas in the tank ignited.

The tank contained a small amount of crude oil and, being tightly closed, the gas within the tank created an extremely hazardous condition in the presence of a flame. The welding electrode was applied to the cracked seam of the tank, and an explosion resulted. Elmer Rudolph, the welder, was instantly killed and a number of persons injured by the explosion; in addition, considerable damage was done to adjacent buildings. The accident occurred in the welding shop of F. L. Henry, of Hynes, Calif.

It will be noted from the accompanying photograph of the weld that, for some reason, luck was with the welder for a few minutes on this job, as he had completed several inches of the weld before the gas in the tank ignited.

Gold-Panning Machine Made by Welding

A machine for separating gold from placer deposits is being manufactured by the Pinellas Machine Co., of St. Petersburg, Fla., and is constructed entirely by arc welding, except for four erection bolts.

With the reduction in the gold content of the American dollar, the yellow metal has become more valuable in terms of our money, and has rendered profitable the working of many alluvial and glacial deposits containing the precious metal.

With a Gold Rush on, These Machines Are in Demand.

Hence, there has been a demand for machines of the type shown and described here. These machines are being used successfully in the gold districts of the Carolinas and Georgia.

Steel plates, angles and bars are used as base material. The separator is a half cylinder, 10 ft. long and 24 in. in diameter, with 12 separator plates welded to the bottom and a baffle along each side to prevent the gold-bearing gravel from spilling over the sides. The separator plates are cut to shape from ¼-in. steel plate.

Over one end of the cylinder is a welded hopper, which receives the placer gravel and feeds it into the cylinder, where it is mixed with water fed from a sprinkling system. As the cylinder oscillates, the gold separates from the waste and falls to the bottom of the cylinder and is held there by the separator plates, which are welded to the cylinder bottom on a slant, and the waste is carried by the water down a drain. The machine is operated by a gasoline engine.

This gold panning machine weighs 700 lb. and will handle 40 tons of gold-bearing gravel a day, during which time it requires emptying only four times.

Dr. Jacobus Elected Head of Welding Society

David Schenck Jacobus, the newly elected president of the American Welding Society, has attained distinction in the fields of mechanical engineering and education. He has been connected with the Stevens Institute of Technology since his graduation therefrom in 1862, has been an advisory engineer with

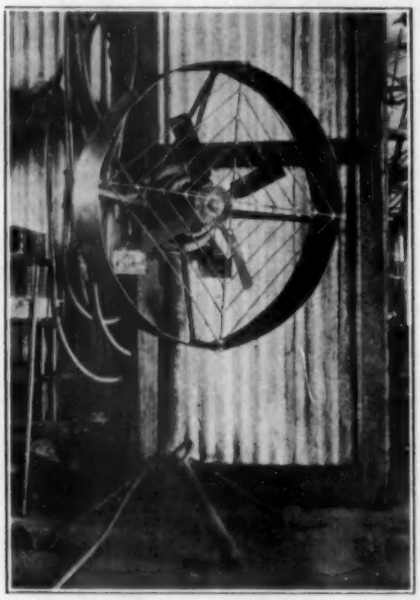
D. S. Jacobus, President A. W. S.

The Babcock & Wilcox Co. since 1906, has served since 1917 as chairman of the Executive Committee of the A.S.M.E. Boiler Code Committee, and served a term as president of the American Society of Mechanical Engineers, and of the American Society of Refrigerating Engineers. He holds membership in many engineering and scientific societies, and has written numerous papers pertaining to various phases of mechanical engineering. He was born 72 years ago in Ridgefield, N. J. His home is in Montclair, N. J., and he maintains offices at 85 Liberty St., New York City.

Home-Made Fan Keeps Texas Shop Cool

A welder in the East Texas oil field who believes in keeping as cool and comfortable as possible under any and all circumstances, showed more than average initiative when he built a large fan for use in the shop where he works, and where during the hot months of the year the heat is almost unbearable.

The fan, which is large enough to furnish an abundance of rapidly circulating air in the shop, is an all-welded device,



Welded Fan for Sultry Days.

constructed for the most part from scrap pieces of material. The fan proper was salvaged from an old Caterpillar tractor, and is mounted, with the motor which drives it, on an old piece of 4-in. pipe split at the bottom with a cutting torch and the legs thus formed bent out evenly to prevent it from tipping over. The fan is driven by a ½-hp. General Electric motor, and creates enough wind to be noticeable all over the shop.

A guard for the fan is made of a piece of ⅛-in. steel plate shaped into a circular band with the ends welded together. This band is attached with pieces of strap iron to the frame holding the motor. Across the front of the guard, pieces of welding rods of different lengths are welded together into a neat design.

Its builder calls the fan not only a "sweat saver" but a "life saver" as well, when working in a poorly ventilated shop on a hot day. A practical feature of the fan is its capacity for purifying the air of a shop, eliminating objectionable gases, smoke, etc.

This useful piece of equipment was designed and built by a welder for the Shell Oil Corp. in their welding shop in the East Texas field camp, near Kilgore. In the shop, on the day when the accompanying photograph was taken, the thermometer stood at 114°.

Cast Iron Can Be Cut With Metallic Arc

By M. L. ROGERS

Cast iron can be cut quite successfully with the metallic arc by using "Fleetweld" electrodes. Use at least 450 amperes or all the heat you can get from your machine. Also, to obtain the best success, use a ¼-in. rod, connected to the positive terminal of the machine. Start at the bottom of the cut and work up. This method gives more speed than the carbon arc. It is preferable to wet the coating before using the rod.

Torch Vs. Grinding Wheel for Reducing Riser Necks

Riser necks of steel castings can be reduced by "washing" them flush with an oxyacetylene torch at two-thirds the cost of grinding, according to cost data given in a recent issue of the *A. E. D. Bulletin*, issued by the Air Reduction Sales Co.

A grinding wheel, 3½x24 in., weighing 98 lb. and costing $40, can be used until it is worn down to 8 in. diameter, leaving only one-ninth the original weight, or 11 lb. Therefore, 98 — 11 = 87 lb. available grinding material, costing $40 ÷ 87 = 46 cents per lb. Since 8 lb. of grinding wheel will remove 54 lb. of steel, we have 46 × 8 ÷ 54 = 6.8 cents as the cost of grinding-wheel material per pound of steel removed.

By grinding, 36 lb. of steel can be removed per hour, with a power consumption of 9 kw., which at 2 cents per kw.-hr. amounts to 18 cents per hour. The power cost of metal removed is 18 ÷ 36 = 0.5 cent per pound. Therefore, the total cost of grinding wheel and power is 6.8 + 0.5 = 7.3 cents per pound of steel removed.

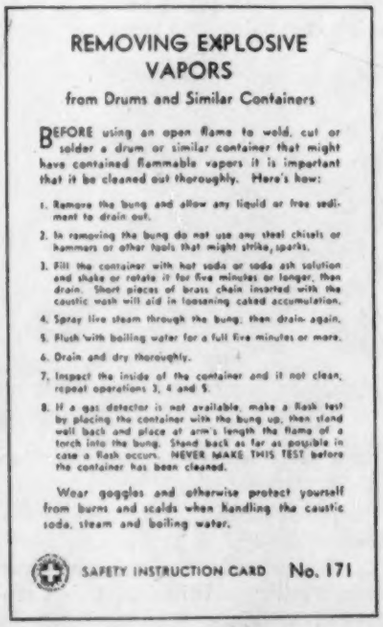
Data obtained by Mr. Helmkamp reported in his paper, "Machine Cutting and Flame Machining by the Oxyacetylene Process," indicate that 3.88 cu.ft. of oxygen will remove 1 lb. of steel. At $1.25 per hundred cu.ft., the oxygen cost per pound of metal removed is 4.85 cents, compared with 7.3 cents by the grinding method.

Comparison of labor costs is even more advantageous to the oxyacetylene process, metal being displaced by it at the rate of 7.15 lb. per minute, compared with 36 lb. per hour with the grinding wheel, or nearly 12 times faster. These data are based on a Style 36 torch tip.

The grinding-wheel costs given above are 1933 prices. If present-day prices were used, the difference would be still greater in favor of the oxyacetylene process.

Safety Instruction Cards for Welders

Two new safety instruction cards of interest to welders are reproduced below. These were recently designed by the National Safety Council, 20 N. Wacker Drive, Chicago, Ill. and are available at one cent per card, with a minimum order of 25 cents. They are printed on white card stock, 3x5 in., and are convenient for carrying in the pocket, or sliding into the pay envelope or can be tacked on the wall over the welder's table. The cards should be ordered by their numbers, the one on "Removing Explosive Vapors" being No. 171, and the one on "Eye Protection" being No. 162.



REMOVING EXPLOSIVE VAPORS

from Drums and Similar Containers

BEFORE using an open flame to weld, cut or solder a drum or similar container that might have contained flammable vapors it is important that it be cleaned out thoroughly. Here's how:

1. Remove the bung and allow any liquid or free sediment to drain out.
2. In removing the bung do not use any steel chisels or hammers or other tools that might strike sparks.
3. Fill the container with hot soda or soda ash solution and shake or rotate it for five minutes or longer, then drain. Short pieces of brass chain inserted with the caustic wash will aid in loosening caked accumulation.
4. Spray live steam through the bung, then drain again.
5. Flush with boiling water for a full five minutes or more.
6. Drain and dry thoroughly.
7. Inspect the inside of the container and if not clean, repeat operations 3, 4 and 5.
8. If a gas detector is not available, make a flash test by placing the container with the bung up, then stand well back and place at arm's length the flame of a torch into the bung. Stand back as far as possible in case a flash occurs. NEVER MAKE THIS TEST before the container has been cleaned.

Wear goggles and otherwise protect yourself from burns and scalds when handling the caustic soda, steam and boiling water.

SAFETY INSTRUCTION CARD No. 171

EYE PROTECTION

MAKING GOGGLES COMFORTABLE

YOU may be required to wear goggles, but you are not required to be uncomfortable while wearing them. Modern goggles are designed for comfort as well as protection. Simply make sure they fit you properly.

Here's how:

1. First see that the nose bridge or strap or chain that connects the lens cups is adjusted to keep the cups in a snug position both sides of the nose, thus leaving no opening for foreign particles to enter.
2. The head band or ear bows should be adjusted so the goggles are held snug against the face without pressing hard against it.
3. The head band should be worn so that it rests lightly on the ears and then passes down around the back of the head at about the base of the skull.
4. If the goggles have ear bows, the bows should be bent to a shape that will prevent them pressing against the ears too hard in any one place.
5. If you are unable to adjust your own goggles, get someone who knows how to do it for you.
6. Keep the lenses clean even if it is necessary to carry a clean piece of cloth or special cleaner for that purpose. Many complaints about the discomfort of goggles are traced to dirty lenses.
7. It is advisable to keep the goggles in a substantial container when not in use to protect them against breakage or being bent out of adjustment.
8. If your goggles fit comfortably but your eyes feel strained while wearing them, explain your trouble to a doctor or an oculist. Your eyes may need attention.
9. Never use another man's goggles unless you are sure they have first been sterilized.

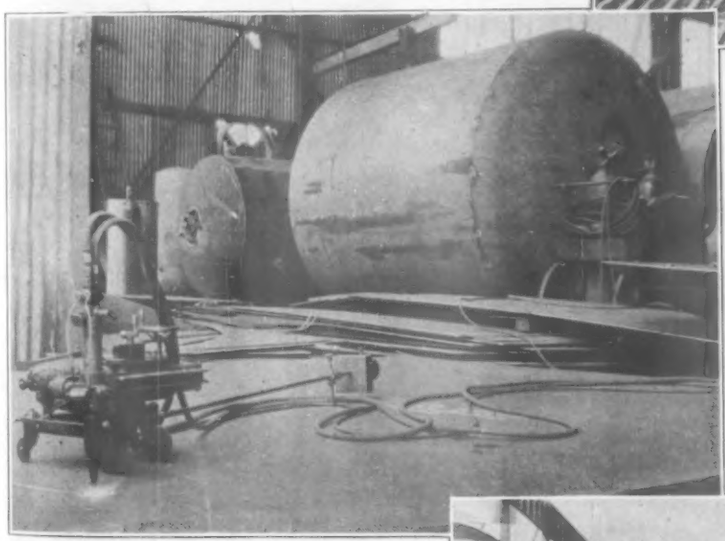
SAFETY INSTRUCTION CARD No. 162

These Cards Can Be Tacked on the Wall or Slipped Into the Pay Envelope.

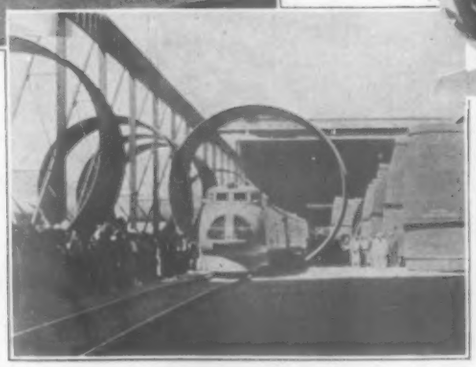
WELDING NEWS IN PICTURES

• Welded tower, 76 ft. high and 9 ft. in diameter, built by American Tank & Equipment Corp., Oklahoma City, Okla., and being shipped to Octane Oil Refining Company.

• Water frozen by brine circulating in 1¼-in. arc-welded pipe will form an out-door ice-skating pond for summer skating. There are 11 miles of this pipe, laid in an area 100x250 ft., also 900 ft. of 8-in. main, welded by the General Machinery Co., Spokane, Wash. Tests with 150-lb. air pressure showed only two leaks. (Photo courtesy General Electric Co.)



• This pump casing has 30 lb. of "Haschrome" applied with the electric arc to the inside surface where severe wear has occurred. Work done by Wiltse Welding Works, Saginaw, Michigan.



• A tank head 98 in. in diameter is being cut out of 5/16-in. plate with this "Airco" automatic torch. The American Steel Pipe & Tank Co., Los Angeles, Calif., are making these tanks for a local brewery.

• Union Pacific stream-line train passing through one of the 30-ft.-diameter welded pipe sections at the field fabricating plant of The Babcock & Wilcox Co. at Boulder Dam.

Liquid-Oxygen Used for Warts and Ivy Poisoning

The use of liquid oxygen for the treatment of warts, skin infections, etc., is meeting with much favor in the medical field, says Elmer Smith, of the Commercial Gas Co., Minneapolis, Minn., who reports that he has treated hundreds of cases of poison ivy, warts and moles with almost universal success. The oxygen is used as a skin refrigerant and is applied to the skin by swabbing. The use of refrigerants in dermatology is not new, but it is only in recent years that the medical profession has realized the full possibilities of this type of skin treatment. As a manufacturer of oxygen, Mr. Smith made the suggestion several years ago to H. G. Irvine and D. D. Turnacliff, Minneapolis physicians, that the liquid be used to treat ivy poisoning, and it was tried with marked success. This and other cases are described in a pamphlet entitled "Liquid Oxygen in Dermatology," by these two Minneapolis physicians, issued in 1929 by the American Medical Association, Chicago.

Sheet Metal Company Adds to Force

About 150 men are now being employed in the Puget Sound Sheet Metal Works in Seattle, Wash., which is being operated on three shifts in order to keep up with orders for equipment. These orders have come from widely diversified sources, but do not include any Government orders. This company uses a great deal of welding in the manufacture of brewery equipment, portable gasoline filling stations, equipment for mining companies and canneries, and contractors' equipment. The present year has turned out much better than they had anticipated, says Harry S. Bowen, vice-president, and the outlook appears good for full-capacity operation for some time to come.

Students Exhibit Their First Airplane

Students of the Benson Tech High School, Portland, Ore., recently completed after two years a low-wing monoplane, which they exhibited at their 16th annual Benson Tech Show. The welded joints indicated a high degree of skill on the part of the students. The plane was built from plans obtained from the Guardian Aircraft Co. It has a wing spread of 35 ft., a length of 22 ft. and a wing width of 5 ft. The fuselage is of steel-tube construction. The completed ship weighs 400 lb.

Get "*H. O. T.*" on Welding

■ By H. O. T. RIDLON

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

Back at the Old Stand —With Apologies

No sir, I haven't forgotten you guys what said keep on pounding out this here-now line of chatter of mine. But, doggone it, I've been just too durn busy of late to know which end was which. You see, 'tis like this: I've done gone went and got myself a new job.

But with breaking in a man to take my old job and getting wised up on the new one myself, I've really been on the jump. The first of the month I had to skip out on the road for a two weeks' run of one and two night stands. Now I've been back in town for two days and here I find myself headed out for two weeks more. So you'll forgive me if this is short, and for missing last month, but honest it just couldn't be helped. But from now on I'll be sort of a traveling reporter for you, and sure hope that the experiences I have and things I see and am able to tell you about will prove of interest and profit to you.

I want to thank you all who wrote to me to continue "the line," and those that wrote in and wanted to know how come I missed last issue. I promise that I'll try hard not to miss again. Glad you like it and, therefore, sure am going to try my durndest to make it bigger and better. And, don't forget, any time you've got something that is really unusual that you've done, give the Old Maestro the complete details, and we'll tell this here-now world about it, for the more we can help each other the more we all profit.

Also, any questions you have about anything, send me the details, and if I don't know the answer, I'll sure try and find it out for you if I bust a leg in so doing.

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A Story About Sid Ward, When He Had the "Shakes"

Well, I guess you haven't forgotten about this guy Sid Ward over in Aurora, Ill., I told you about a couple of issues ago. Anyhow, I might go back a few years and tell you a story about Sid. I'm sure he won't mind. It's like this: Several years ago Sid was taken very sick, and I've been told that he had a slight stroke. But a little thing like a stroke doesn't make a guy like Sid lay down and quit. No sir, he just kept on fighting and before long he was back in his shop working away same as always, with the exception that he had a pretty bad case of the shakes. So Sid scouted around and found himself one of those old torches that's about a yard long. Having this, he was able to brace his elbow against his side and get a strangle hold on the torch and, with all his experience and cunning to back him, he is still able to lay down a right smart bead. About that time, Sid had a helper who was learning to weld. He hadn't known Sid before he was sick, and he pulls this one on him: "Mr. Ward, I've been here four or five months learning to weld as your helper, and for the life of me I can't get that funny little shaking motion you use to get that nice ripple with. How do you do it?"

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Those Two Brothers Have Promised Us Their Story

Those two brothers at last got their shop finished. The weather and what not was against them for quite a spell. But now it's done and they've moved in, and things are humming right along. They've promised to tell you soon in their own words something about the business and how they get it. But I'll tell you now, in my words, which are few and much to the point. It is by turning out better welding than any one around those parts ever saw before, and by getting out and selling. The thing they try to sell the most is hard-surfacing, because that is something a welding shop can build a sales story around and talk profit and not just dollars and cents. And, Brother, I mean what I say; they get out and sell and contact every prospect regularly in the district they serve. They read, study and keep up-to-date on everything that has to do with their bread and butter, even if there isn't any place they can use it. They charge a fair price for every job they do, and insist that they make a profit on every job.

They followed the suggestion of Stuart Plumley in his book on oxyacetylene welding and cutting for their cost cards. It's a darn good book for any welder to read. These boys figure that it costs them 50% of material and labor costs to do business; so they take that total and add 50% for profit. It is working out perfectly for them, and their business is on the increase, and every job shows a profit.

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Now We Close With The Monthly Text

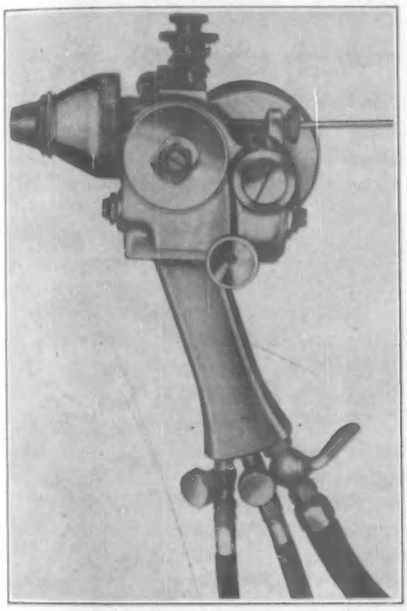
The thought of the month: Things really are getting better; you can help.

New Equipment

Metal-Spray Gun Has Many Features

An improved construction that materially reduces maintenance, is a feature claimed for the new "Metalspray" gun, manufactured by the Metal Spray Co., 113 Llewellyn St., Los Angeles, Calif. All parts are said to be well proportioned, the gears are extra large, and different sizes of wire up to ⅛ in. can be used without changing the nozzle.

The new design permits the gas to be lighted even before the wire is introduced



New Design of Gun for Spraying Metals.

into the nozzle, without any danger of internal explosion. The wire channel can be larger than the wire, it is claimed, thereby eliminating binding and clogging in operation and permitting the use of wire of non-uniform size. Either coils of wire or short pieces or rods can be fed continuously, one after the other.

It is claimed that the special nozzle permits quick and accurate adjustment of the flame and reduces likelihood of backfire. The same nozzle is used for all metals, and has a special nickel-copper alloy tip. Therefore, it is easy to keep the seats permanently tight, practically eliminating seat repairs and gas leaks.

Individual controls for acetylene, oxygen and air are provided on the gun itself, permitting quick adjustment to obtain the correct neutral flame.

The gear case is completely enclosed and packed with lubricant. With the knurled wire-feeding wheels located outside the gear case, the case does not have to be opened to stop wire feeding, so the gear-case lubricant does not become contaminated with metal particles or scale from the wire. The pressure exerted by the wire-feeding wheels is easily varied.

The use of strong, light, durable alloys has allowed a reduction in weight compared with the previous type of gun. The Model 126 gun is suited for heavy deposits of hard or soft metals and will deposit 6 lb. of steel in one hour, it is claimed. The Model 81 is a smaller gun, for use with 12-gage wire in coils or reels, and produces a very fine spray and a dense deposit.

New Electrode for Class I Welds in any Position

A general-purpose welding electrode, designated as the Type W-22, has been added to the General Electric line of arc-welding electrodes. This new electrode is of the heavily coated or shielded-arc type and produces welds of the quality required for Class I pressure vessels according to the A.S.M.E. Boiler Construction Code. Its distinctive feature is that it may be used in any position—that is, for flat, vertical, or overhead welding—and, at the same time, has deep-penetrating properties, it is claimed, making it equally suitable for butt and fillet welds.

Tests on all-weld-metal specimens made from Type W-22 electrode show the following average results, which more than meet the rigid Class I requirements: Tensile strength, 65,000 to 75,000 lb. per sq. in.; elongation, 20% to 30% in 2 in.; and impact resistance, 30 to 45 ft.-lb. (Charpy). In addition, welded joints average 35% to 60% elongation when tested by the free bend method and x-ray, Class I.

With these physical properties being obtained without regard to the position in which the welds are made, there is no necessity for moving the work to accommodate down-hand welding.

The W-22 electrode has a wide field of application in the fabrication of large structures, such as ships and locomotives, where it is impossible or impracticable to move the work into a special welding position—and in the welding of such fittings as nozzles and flanges to pressure vessels, where handling costs are less if positioning of the work is unnecessary.

Standard Charge Scale and Cost System for Shops

A "Welders' Standard Charge Scale" system, for use by those doing a jobbing business in oxyacetylene welding and cutting, is being introduced to the trade by the Hofton Engineering Co., 5106 Agnes St., Kansas City, Mo.

The system consists of a combination work ticket in duplicate to cover all the materials used in oxyacetylene welding, including labor. The tickets are in simple form, and the welder should have no difficulty in filling in the spaces and carrying the extensions out to the total column, thereby arriving at the actual cost of the job.

In addition to the work tickets, the system also includes a "Welders' Standard Charge Scale," by which the welder can compute quickly his acetylene and oxygen costs for any size of tip used. The figures are based on the drill size of the tip orifice, and prices are based on oxygen at 4 cents and acetylene at 6 cents per cu. ft. Also on this scale is a table to arrive at cutting costs and one for welding rod.

Truck-Mounted Welder for Repair Work

A new arc welding unit, truck mounted, is being manufactured by the Welders Supply Co., 311 E. Third St., Tulsa, Okla., for oil-field repair work. One of these units, shown in the illustration, consists of a 300-ampere General Electric generator and a 1½-kw. auxiliary generator for operating small tools, all mounted on an International truck with a Welsco power take-off, making a compact portable unit. The extended generator shaft can be used for various purposes, some oil companies using it to pick up waste oil or to operate small lines on stringer wells.

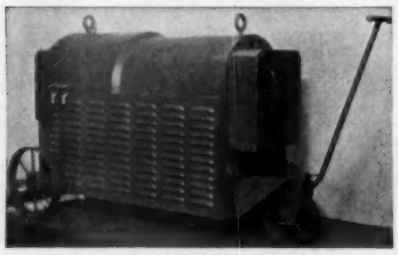
Portable Repair Unit, With Welder, for Oil-Field Work.

Improved Arc Stability and Higher Efficiency

The old-style power-consuming reactor is no longer needed with the "Universal" arc welder, since the adoption of a principle of arc stabilization that is said to be entirely new. The Universal Power Corp., 1719 Clarkstone Road, Cleveland, Ohio, manufacturers of the "Universal" welder, state that the arc stability has been made so smooth that very little time is now lost in starting and maintaining the arc. A very high machine efficiency is claimed. In fact, it is said, the power consumption has been so reduced that the margin saving in power and time over the old-style machine is enough to pay investment charges on the original cost of the new type of welder.

Heavy-Duty Welder for Steel Mills and Shipyards

Westinghouse engineers recently developed a new 400-ampere direct-current welder driven by a 25-hp., 230-volt, d.c. motor. This machine is of the unit frame construction. The polarity is easily reversed by turning a simple thumb switch.



Welder With D. C. Drive.

The machine is designed for use with either bare or coated electrodes, and is particularly adaptable for the heavy service required in steel-mill and shipyard production.

Shielded-Arc Electrode for High-Tensile Steels

Welds with tensile strengths of 85,000 to 100,000 lb. per sq. in. can be made with the new arc-welding electrode, "Shield-Arc Eighty-Five," according to an announcement from The Lincoln Electric Co., Cleveland, Ohio. This electrode is designed especially for use on high-tensile steels. Here it provides high tensile strengths and ductility of 15% to 20% elongation in 2 in.

"Shield Arc Eighty-Five" is a heavily coated electrode of the shielded-arc type. It is particularly suitable for the welding of those low-alloy structural steels which, on normalizing, have tensile strengths under 100,000 lb. per sq. in.; for example, Cromansil, low-carbon nickel steels, structural silicon steels, low-carbon manganese steels, vanadium steels, and, in general, all low-alloy steels under 0.30% carbon.

It is obvious that the chemical composition of the plate being welded will affect the tensile strength and ductility of the weld. When deposited on mild steel plate, the weld metal has a tensile strength of approximately 78,000 to 85,000 lb. per sq. in., yield point 60,000 to 70,000 lb. per sq. in., and 15% to 20% elongation in 2 in. in the as-welded condition.

Welds in high-tensile plate have a higher strength than that given above. For example, a butt weld in a 5/8-in. Cromansil plate, ground flush with the plate, when tested in the as-welded condition did not fail, but the plate broke at 89,600 lb. per sq. in., and the outside fibers of the weld showed an elongation of 25% in a free bend test. A similar specimen stress-relieved broke through the center of the weld at 86,250 lb. per sq. in., and showed a yield point of 58,600 lb. per sq. in. and an elongation in 1 in. across the weld of 34.4%; in a free bend test, the outside fibers showed an elongation of 32%.

"Shield Arc Eighty-Five" is said to be suitable for flat, vertical and overhead welding, and is available in 5/32 and 3/16 in. sizes.

Trade Literature

"Oxyacetylene Welding and Cutting," a course of instruction on the care and use of equipment, including welding procedures for commercial metals and alloys, has been issued in a new addition by the Torchweld Equipment Co., 1035 W. Lake St., Chicago, Ill., and is priced at 50 cents per copy. In the 80 pages of this booklet, such topics are discussed as flame adjustment, preheating, expansion and traction, welding tables and fixtures, determining costs, finishing of welds, production work, joint design, lead welding, and welding procedure for steel, cast iron, copper, aluminum, and other metals.

Enduro 18-8 stainless steels are discussed in Bulletin 125, which gives authentic metallurgical and fabrication data, including procedures for forging, flanging, deep-drawing, riveting, welding, soldering, machining, sawing, annealing, and pickling. A table lists the degree of corrosion-resistance of these steels to more than three hundred chemical reagents, solutions and products under varying conditions of temperature and concentration. Copies of this booklet can be obtained from the Republic Steel Corp., Massillon, Ohio.

"Anaconda" welding rods for gas and electric welding, is the subject of a new publication by The American Brass Co., Waterbury, Conn. The booklet includes detailed information on the welding properties, melting points, weight and strength data, method of procedure, and the individual characteristics of each of the fourteen different rods listed. The oxyacetylene gas torch, electric carbon arc, metallic arc, and carbon arc torch methods of welding with copper alloy welding rods are also described and illustrated.

"Dowmetal," a very-light-weight structural material, consisting largely of magnesium, is discussed as to its physical and chemical properties, heat-treatment, fabrication, and finishing, in an interesting 67-page booklet issued by The Dow Chemical Co., Midland, Mich. Several different alloys of this metal are described, each differing somewhat in properties and workability. Information is given on welding by both the gas and electric-resistance processes.

"The Welder's Handbook" has been issued in a new edition by the American Steel & Wire Co., 208 S. La Salle St., Chicago, Ill. Information is given to aid the welder to select the proper rod and to manipulate the arc or torch correctly. Charts show welding speeds for various types of rods. The chemical composition of all rods is given, and also the recommended current values in the case of electrodes.

Zinc-coated sheets subjected to a special heat-treatment and sold under the name "Galvannealed Sheets," are described in Bulletin 200, issued by the Republic Steel Corp., Youngstown, Ohio. These sheets are readily spot-welded and soldered and resist flaking under high temperatures, it is claimed. The booklet shows some typical products made from these sheets.

The use of graphic ammeters, with voltmeters, enables making the proper set-up for resistance welding and aids in controlling the operations so better welds are produced, according to Bulletin 334, issued by The Esterline-Angus Co., Indianapolis, Ind. Typical graphs are shown and interpreted, and several graphic instruments are illustrated.

For the operation of resistance welders and for other industrial purposes, a new type of air-operated valve has been developed by C. B. Hunt & Son, Salem, Ohio, which is said to be very quick acting and has no metal-to-metal wear and no seats or glands. This valve is described in Bulletin 101-V, recently issued by the manufacturer.

"Oil Field Welding" has been issued in a new edition by the Stoody Co., Whittier, Calif. It gives the details of how to reclaim drilling tools and how to apply hard-surfacing metals and Borium, by both the arc and gas methods. This booklet includes much new material, including illustrations.

"Economy and Electric Welding" is the subject of a leaflet published by P. W. Fassler, 904 Fisher Bldg., Detroit, Mich. This is a dissertation on resistance-welding and arc-welding methods in this country and abroad, with suggestions towards further economies.

The "Lincontrol," for increasing or decreasing the welding current merely by tapping the electrode on the work, is described in a leaflet issued by The Lincoln Electric Co., Cleveland, Ohio.

Commercial News

E.T. Scott Becomes Head of Cleveland Welding School

Edward T. Scott, secretary-treasurer of the Cleveland School of Welding, Inc., of Cleveland, Ohio, has been elected president to fill the vacancy created by the death of R. K. Randall. Mr. Scott, who has been with the school since it was founded, will continue as treasurer, and Miss Mary L. Miller has been elected secretary. The school will continue with the high plane of instruction for which it has become noted, says Mr. Scott. Enrollments are increasing rapidly, with the night class full and the day classes comfortably so. A recent survey shows that 50% of the enrollments are upon recommendation of graduates of the school.

"Hot" Ridlon Joins Rego Organization

H. O. T. Ridlon has joined the sales organization of The Bastian-Blessing Co. as district manager with headquarters at the company's main office at 240 E. Ontario St., Chicago, Ill. Mr. Ridlon was formerly with the Barrett Hardware Co., of Joliet, who are "Rego" sales agents. He is known among readers of *The Welding Engineer* as the author of the "Get 'H. O. T.' on Welding" series which were run during the past year.

P. W. Fassler Opens Office as Consultant

P. W. Fassler, widely known authority on spot, seam and flash welding and other forms of electric welding, has opened offices in Room 904, Fisher Building, Detroit, Mich., under the name of P. W. Fassler & Co., to do consulting work in electric welding. For several years Mr. Fassler was manager of the electric welding department of the Fisher Body Corp.

Recent Buyers of Metal-Spraying Equipment

Interest in the metal-spraying process and extension of its field of application continue unabated. The Metal Spray Co., 113 Llewellyn St., Los Angeles, Calif., report that the Standard Oil Co. of Indiana, Whiting, Ind., and the Atlantic Refinery, Philadelphia, Pa., each recently purchased two "Metalspray" units. Among other recent purchasers are the following firms: Bamber & Co., Long Beach, Calif.; Sinclair Refining Co., East Chicago, Ill.; Metal Spraying Corp., Milwaukee, Wis.; U. S. Navy Yard, Bremerton, Wash.; Schenectady Metallizing Co., Schenectady, N. Y.; and Invincible Steel Furniture Co., Manitowoc, Wis. These concerns are using these units for various purposes, including the lining of hot oil chambers with aluminum, reclaiming worn machine parts, and general job spraying.

A. J. Howell has been appointed manager of the Pacific Coast district of Revere Copper and Brass Incorporated, with offices in San Francisco. He succeeds R. H. Binns, Jr., who has moved to the executives offices in New York City, as assistant general sales manager. Mr. Howell has been with Revere on the Pacific Coast since the opening of an office there in 1932 and for many years previously represented the Rome Division of Revere on the coast.

E. H. Bruner, secretary of the Chicago Wheel & Manufacturing Co., Chicago, Ill., and a pioneer in the grinding-wheel industry, died the early part of April. He had been associated with Henry T. Miller, president and founder of the company, since 1896. Arthur T. Dalton, formerly manager of the Detroit branch of the company, has been appointed to fill the vacancy caused by Mr. Bruner's death.

The C. E. Phillips Co., 5443 Twelfth St., Detroit, Mich., have been appointed national distributors for Dirigold wire for application by the metal-spraying process. This wire gives a good imitation of gold and is said not to tarnish. It is furnished in 18-gage size. Dirigold is harder than gold, makes a better bearing surface than bronze, and resists heat corrosion, it is claimed.

Wm. Maxwell, of Mt. Pleasant, Mich., has discontinued his job welding business and has entered the welding supply business. He has taken over the distribution of the special fluxes manufactured by the Pratt-Brayman Co., Bedford, Ohio, and is also handling "Rego" welding and cutting apparatus.

The death of E. L. Work, of The Ideal Face Shield Co., Columbus, Ohio, which was announced in the April issue of *The Welding Engineer*, will not affect the business policies of the company, and their business will be continued as in the past, states D. E. Work, secretary-treasurer.

The Metal Spraying Corp., 125 E. Wells St., Milwaukee, Wis., has been organized to do custom job work and to sell "Metalspray" guns and related equipment and supplies. The firm's shop is located at 3132 W. Garfield Ave., Milwaukee.

The Weldit Acetylene Co., Detroit, Mich., announce the appointment of the York Engineering and Supply Co., 1583 Clybourn Ave., Chicago, Ill., as distributors of their complete line of welding and cutting equipment and supplies.

Handy & Harman, producers of the low-melting-point alloy "Sil-Fos," have made arrangements with the Air Reduction Sales Co. for the distribution of this alloy from all "Airco" stations throughout the United States.

The welding school conducted by The Lincoln Electric Co., Cleveland, Ohio, has a full advance enrollment up to the end of August. Reservations have also been made as far ahead as the end of September.

The John Huntington Polytechnic Institute, Cleveland, Ohio, in cooperation with The Lincoln Electric Co., started another welding engineering course on May 7th with a full enrollment.

Notes From the Field

Price Is OK, But Not for 15 Minutes' Work

A recent experience taught Tom Munger, proprietor of the Munger Welding Co., Adrian, Mich., that he should not tell a customer he can have his job "in about 15 minutes," especially if that customer undervalues the worth of skilled workmanship.

A farmer brought in a small job and inquired the price to weld it and was told it would be about 50 cents. This price was agreeable to the farmer, since a new part would cost about a dollar, so he left the part with Mr. Munger and was going out the door when he turned about and asked how long it would be before he could get it. "In about 15 minutes," said Mr. Munger. The farmer went back, picked up the part, and remarked that he wouldn't pay anybody in the world 50 cents for 15 minutes' work. Persuasion and explanation were used, but the farmer was adamant, and he departed with his part unwelded.

After this, says Mr. Munger, he'll ask the customer how long he can give him to do the job, instead of telling him how long it will take. Had the farmer known that his job would actually have taken only 4 or 5 minutes, what would he have said to that?

Hard-Faces Plow Share, Then Forges Out Point

A large business in the hard-facing of plow shares has been built up by the L. F. Palm Co., Defiance, Ohio, using a novel method of repair which they, however, claim is not original with them.

On both new and old plow shares, they apply a layer of Stoody Self-Hardening rod by the oxyacetylene method, on the bottom side. This layer is about ½ in. wide and is applied up to about 1/16 in. of the side, but not to the very edge. The share is then heated in the forge and drawn out by forging, giving about 5/16 in. more point.

The edge obtained is considerably harder than the original material and gives much longer service.

Two large orders for Naylor Spiral Weld Pipe for gas lines have been booked by Naylor Pipe Co., Chicago, Ill., according to a recent announcement by E. W. Hough, vice-president and director of sales. Five miles of 16-in. pipe will be required for a gas vacuum line for the Phillips Petroleum Co., Burbank, Okla., and several miles of 16-in. pipe will be used for a pressure gas line for the American Natural Gasoline Co., Shamrock, Texas.

The San Diego Consolidated Gas & Electric Co., San Diego, Calif., recently completed an extensive job in pipe welding at Encinitas, where widening of the highway necessitated changing the company's transmission line. In addition to this work, new service leads were welded to the line for a considerable distance where no service is at present required, but where such service needs are anticipated for the near future.

The Public Works Department of the City of San Diego, Calif., recently awarded a contract to the Standard Iron Works, of that city, for the construction of nine all-welded garbage-disposal truck bodies to be mounted on International truck chassis. These truck bodies are of the dump type, tipping to an extreme angle of 54°. The all-welded construction makes for great durability and efficiency in operation.

An all-arc-welded, allsteel semi-trailer, 20 ft. long, 8 ft. wide, and 6 ft. high, and weighing 5940 lb., including a dual wheel assembly, was recently delivered to Guy E. Truax, of Akron, Ohio. The trailer was made by the George Welding Co., 79 W. Exchange, Akron, Ohio, whose proprietor, Dale George, states that his trailers are 1500 to 3000 lb. lighter than similar-capacity trailers of riveted construction, thereby making possible a larger pay load.

Farmers are reticent about having advertising signs placed on their property. The Menna Welding Co., Toledo, Ohio, has solved the problem by making attractive signs advertising "Menna Welding Service" and leaving space on which the farmer can advertise his wares to those passing along the highway. Thus the sign takes on some utility for the farmer, and he readily grants permission to have it put up.

As a result of a rapid pick-up in their sales, the Defiance Pressed Steel Co., Defiance, Ohio, recently added many more operators to their welding department and have purchased several new arc-welding machines. At present, the factory is operating three shifts. The company makes an all-welded automobile steering wheel and other products.

The Haulman Welding Works, of San Diego, Calif., recently completed the welding of several hundred feet of 16-in. fuel-oil pipe line for the U. S. Naval Fuel Depot in San Diego. Butt-welded joints were employed on the line. Shielded-arc electrodes were used, two beads being required to complete the rolling welds, and three on the position welds.

An extremely heavy job in truck body welding was recently completed by the Hooper Iron Works, of 1040 S. Orange Drive, in Hollywood, Calif. This unusual job comprised the building of an all-arc-welded gold extractor, in which a great deal of heavy structural material is used. It is to be a portable machine, being mounted on a large truck.

The W. A. Bechtel Co., pipeline welding contractors, of San Francisco, Calif., were recently awarded a contract by the Public Utilities Commission for the welding of approximately six miles of 44-in. welded steel pipeline. This will be a section of the Hetch-Hetchy aqueduct for the city of San Francisco now nearing completion.

The Pacific Welding Co. is the name of a new welding shop recently opened for business at 1838 E. 39th St. in Los Angeles, Calif. The shop is under the management of the joint partnership of H. L. Mills and M. Marco, who were formerly associated with the Granneman Welding Works on S. Santa Fe Ave.

The "New Deal" Welding & Machine Shop recently opened for general job welding and repairing at 5110 Whittier Blvd., in Los Angeles, Calif. The shop is owned by George Hug, who with John Yoeman formerly operated a welding and repair shop at 4475 Whittier Blvd.

The Control Welding Co., Delaware, Ohio, is building some all-gas-welded 50-gallon gasoline tanks to be used by trucks for long trips, according to E. T. Hart, proprietor. These tanks are 51 in. long and 15 in. square and are constructed of 16-gage sheet.

Construction requiring a large amount of welding is under way in Huntington Beach, Calif., in the erection of a butane-gas fractionating plant, storage tanks and loading units for O. C. Field. This work is being handled by Parkhill-Wade, Inc.

The Johnston Welding Co., Akron, Ohio, are moving from 54 E. Cedar to 46 W. Exchange, according to H. C. Johnston, proprietor The new shop will be 50x110 ft. in size and will contain

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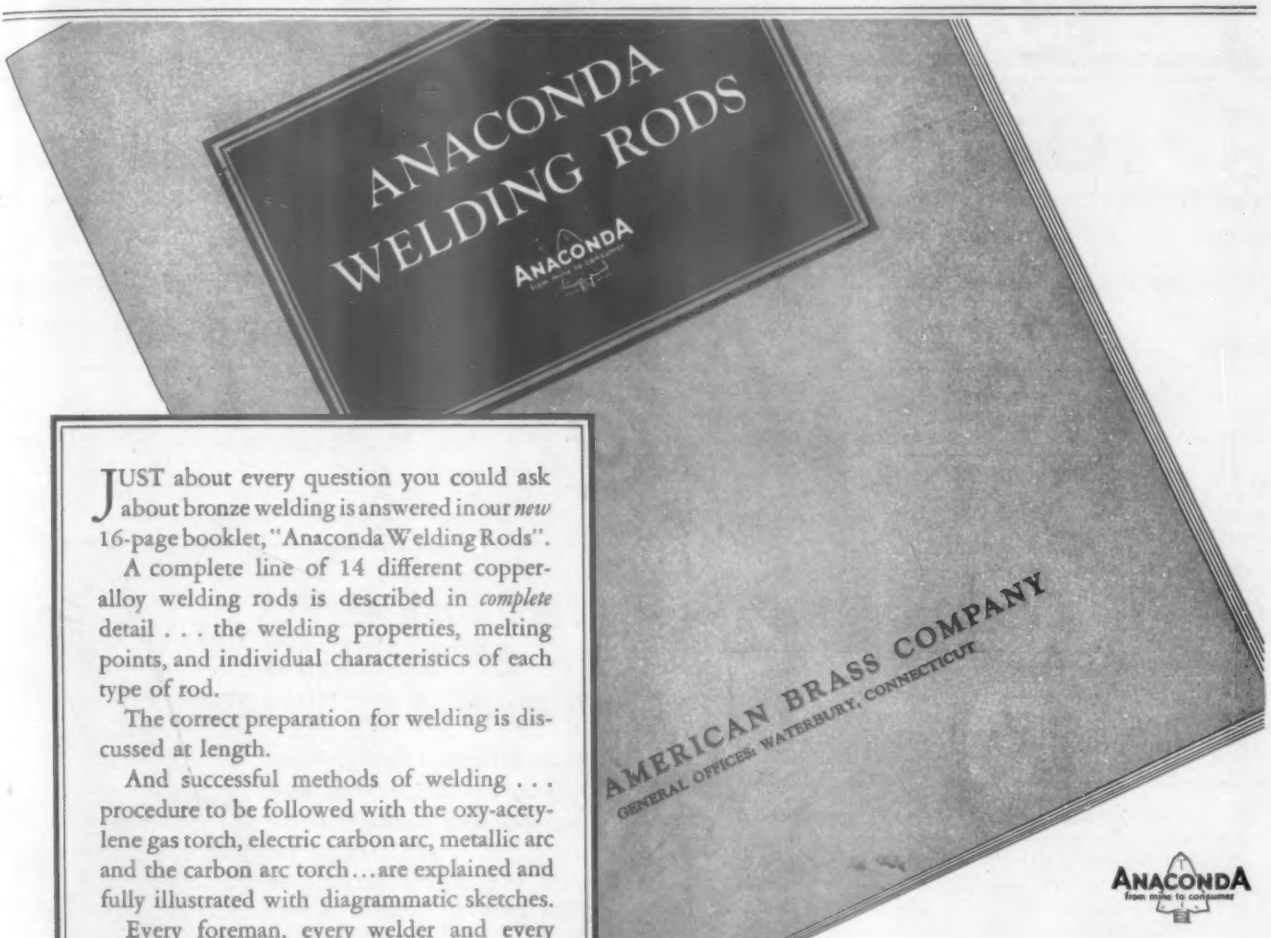

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